

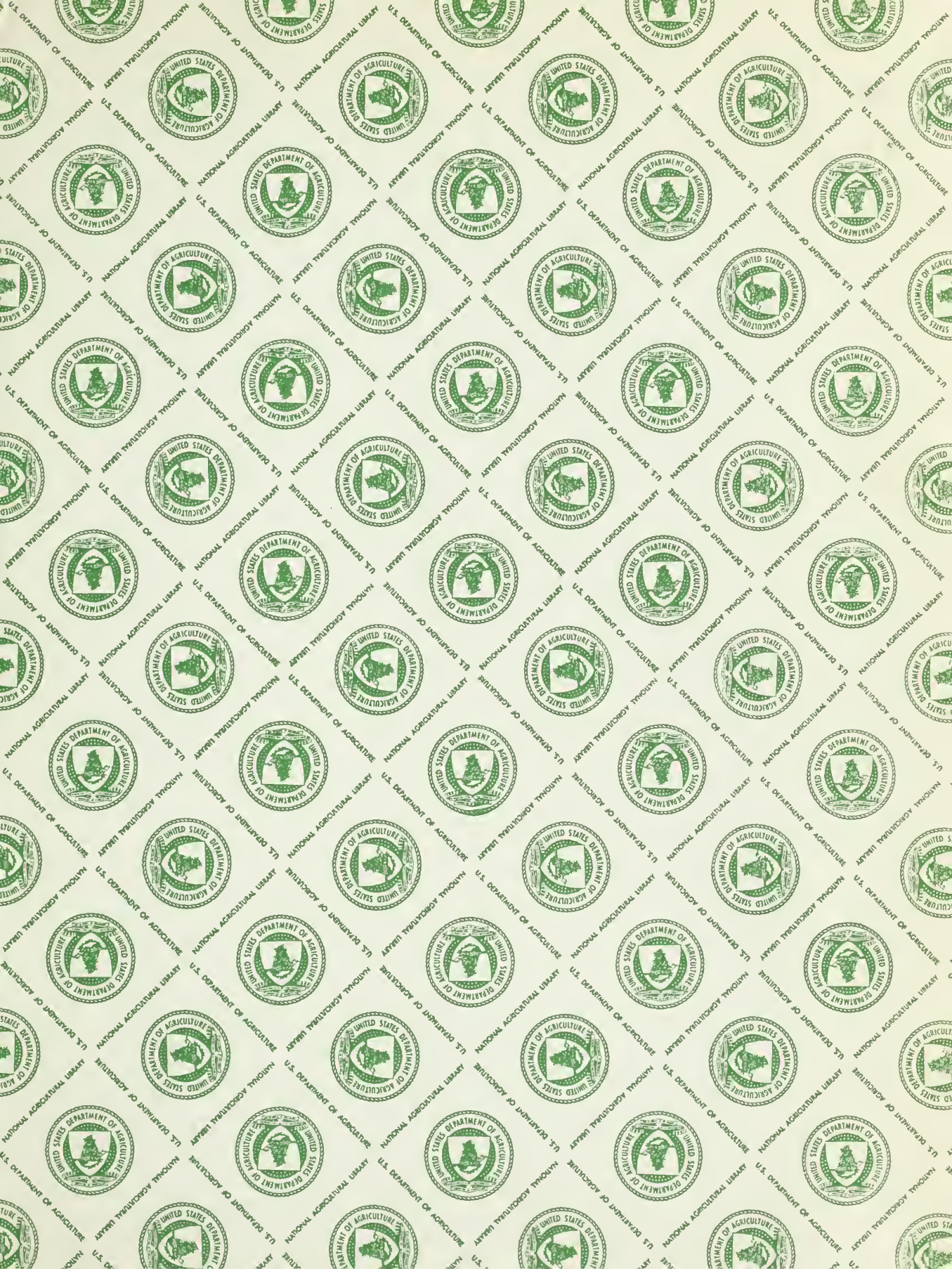
## **Historic, archived document**

Do not assume content reflects current scientific knowledge, policies, or practices.















66 Fi  
b. 2

January 1964

Vol. 25, No. 1

# FIRE CONTROL NOTES



U. S. DEPT. OF AGRICULTURE  
NATIONAL AGRICULTURAL LIBRARY

JUL 23 1964

CURRENT SERIAL RECORDS

U.S. Department of Agriculture  
Forest Service



# FIRE CONTROL NOTES

*A quarterly periodical devoted to forest fire control*

## CONTENTS

<i>Page</i>		<i>Page</i>	
4	The place of southern California in the Nation's fire problem M. M. Nelson	12	Paper packaging for airdrops Division of Fire Control, U.S. Forest Service
6	Lightning damage to Douglas-fir trees Alan R. Taylor	13	The large tanker—extending its use John A. Anguilm
8	Fire prevention that worked Joseph Couch	14	Summary of fire losses in Alaska Bureau of Land Management, U.S. Department of the Interior
10	Improved lunch for firefighters Equipment Development and Testing Center, Missoula, Mont.	15	Report on aerial fire detection study Louis L. Davis
11	A technique in tower orientation James E. Mixon		

## INFORMATION FOR CONTRIBUTORS

Please submit contributions through appropriate channels to Director, Division of Fire Control, Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250. Articles should be typed in duplicate, double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and organization.

Authors are encouraged to include illustrations with their copy. Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints or India ink line drawings are acceptable. Captions for illustrations should be typed in the manu-

script immediately following the paragraph in which the illustration is first mentioned, the caption being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the caption to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

**Cover**—Wildfire in southern California: damage to valuable watershed and a threat to homes and other improvements

FIRE CONTROL NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D.C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. Use of funds for printing this publication approved by the Director

of the Bureau of the Budget (Sept. 16, 1963).

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, 20 cents a copy, or by subscription at the rate of 75 cents per year, domestic, or \$1.00, foreign. Postage stamps will not be accepted in payment.



234765

UNITED STATES DEPARTMENT OF AGRICULTURE  
FOREST SERVICE  
WASHINGTON 25, D.C.

IN REPLY REFER TO

To Readers of Fire Control Notes

Early in 1936 the participants of the Fire Control Meeting at Spokane, Washington, agreed that a publication was needed to exchange fire control ideas and developments nationwide. Publication of Fire Control Notes began later that year. Since then, the original concept of a national medium for interchange of ideas has grown to international scope. Our distribution list now shows 172 copies being sent to 55 foreign countries.

Time and progress mean change. The traditional size and format of Fire Control Notes is changing with this issue. The new format is much more adaptable; it will do the job more efficiently, allow more illustrations, and provide easier reading.

Fire Control Notes is published to disseminate ideas that will help readers do a better fire control job. Discoveries, new methods and techniques, and different adaptations are vitally needed. No job, no matter how well done, can make its maximum contribution until the story is known by others.

MERLE S. LOWDEN, Director  
Division of Fire Control



# THE PLACE OF SOUTHERN CALIFORNIA IN THE NATION'S FIRE PROBLEM

M. M. NELSON, *Deputy Chief, U.S. Forest Service*  
*National Forest Protection and Development*

My intent is to draw some contrasts and similarities between southern California's fire problem and that of the rest of the Nation. I hope to show evidence of strong team effort directed toward the fire problem here, and while the Federal investment has been significant, it is a two-way street.

We are frequently asked, candidly and pointedly, what the U.S. Forest Service is doing in southern California. Why do we spend about a quarter of our fire protection money on 2 percent of the National Forest land? It has been said, referring to southern California people, "This is *their* problem—one *they* should solve themselves." To most of us in the Forest Service the very words "their problem" applied to southern California have a strange sound. With Robert Frost we can say "whose woods these are I think I know," for since 1905 these National Forests and their inseparable association with the total environment of southern California have been *our* problem—*ours* as a team member with all other individuals and agencies who accept responsibility for management, protection, and development.

While speaking of mutual interest in mutual problems, I might say that I was keenly impressed at our last budget meeting in the Department of Agriculture by a statement made by our newest Assistant Secretary. He is a Californian. His statement was, "There wouldn't be any Los Angeles, as we know it, if it weren't for the work the Forest Service is doing in the high mountains—and I mean that literally." That may need some explanation. Let's illustrate with this glass of water. Who can tell me where it came from? Did it first fall as rain on the San Bernardino or Angeles National Forest? Just as likely it fell in the high mountains of Wyoming on the Bridger National Forest, the Manti-LaSal in Utah, the Carson in New Mexico, or the Apache in Arizona. Or perhaps it was skied upon while on the Routt or Uncompahgre Forests in Colorado. It could have come from any of these or from many other National Forests. There is sound fact for a sign posted in a pass east of Silverton on the San Juan National Forest of Colorado. This sign reads, "You are now standing on a watershed which supplies water to the City of Los Angeles." So, you see, you have a vital interest in how we protect and manage National Forest resources in much of the West. They play an important part in sustaining southern California.

In order to place southern California's forest fire problem in perspective, let's first take a broad look at the national picture. Last year 115,345 forest fires burned 4,078,894 acres in the United States. This despite the fact that the National Forests were blessed with their smallest burn (85,457 acres) since records were started 57 years ago. Also, the State of Alaska contributed only 29,000 acres as compared with an average yearly burn of over 800,000 acres. Great forest fires of historical record have swept enormous areas in virtually every portion of this country. There are accounts of fires exceeding a million acres in such scattered locations as Maine, Oregon, Wisconsin, Idaho, Michigan, Montana, Kentucky, and West Virginia. As recently as 1957 forest fires on public lands in Alaska blackened over 5 million acres in a month, causing a Bureau of Land Management fire man to state, "Here, we contend with no lookout towers, very few roads, vast distances, long hours of daylight, high temperatures, strong winds, bad terrain, frequent lightning strikes, very little manpower, and next to no equipment—it's really a tough show."

It can be, and has been, a "tough show" in most forested areas when the weather dries the vegetation to a point where fires spread rapidly and conditions are unfavorable to control. Numerous areas have such factors.

There are sections of the country where we can point to rugged, inaccessible mountains, or to great volumes of forest fuels. There are areas with dry climates, having periods of severe fire weather. There are places where masses of people and their activities complicate the control of fires. But there is no single area in this country where factors favoring forest fires combine so frequently and last so long as here in southern California. Also I doubt there is a place more dependent on maintaining balance among elements of environment, such as soil and water. Certainly there is no place where this balance has been more often and disastrously upset by fire. Southern California's place in the Nation's forest fire problem, while small geographically, is large indeed measured by fire's effect on 7 to 8 million people and indirect effect on the Nation as a whole.

Yes, the problem and potential is of national recognition and concern and can be indicated in many ways. Expenditures through the Department of Agriculture and the Forest Service have increased from \$886,000

in F.Y. 1955 to \$2,744,844 in F.Y. 1963. This year an additional \$300,000 has been added. Unbudgeted emergency funds for fighting forest fires have totaled \$20,691,100 in the last 5 years.

Two of eleven flood prevention projects are located in the Los Angeles and Santa Ynez Rivers. Here, through 1962, \$12,900,000 have been spent on improvements and fire protection measures. Under authority of the National Flood Control Act, money is made available to rehabilitate fire-damaged lands where life or property is threatened. Fifty-five southern California watersheds have been treated at a cost of \$1,715,000.

Single fires on these National Forests have cost a million dollars or more to suppress, despite strong cooperative support given by State, county, and city fire units.

Men who have fought fire in southern California are acutely aware of a greater stake in these mountains. More than 50 firefighters, many from other States, have lost their lives dealing with intense, fast moving fires—typical of these precipitous watersheds. Yet I have never heard a fireman suggest we resign from the southern California fire team.

Some people, though, wonder aloud “a quarter of the protection money spent on 2 percent of the National Forest area?” Others have added, “Yes, but we are not moving ahead fast enough; losses are unacceptable; we need more research, more equipment development, more hazard reduction, more access roads, more firebreaks; more of everything.” I agree and share concern with these people. But for a moment let’s view southern California’s place in the national fire picture from the inside looking out.

This area has been called a great outdoor fire laboratory, an advanced school for firefighters, a crystal ball in which to view future land management under stress of fires, floods, and population pressures. Certainly it has been a proving ground for firemen and their equipment. Large fires in recent years have names familiar to hundreds of men from many National Forests in a dozen States. Big Dalton, Devils Peak, Refugio, White Mountain, Fish Fork, Barrett, Monrovia, Woodwardia, Waterman Canyon, Stewart, Palomar, Inaja, and many more.

Innovations and progress usually occur closest to the need. Certainly this has been true throughout the southern California area. I think, of course, of the great potential of the new Fire Research Laboratory, but also of many other signs of progress and accomplishment:

The Arcadia Equipment Development Center, soon to move to expanded facilities.

The pioneering at the San Dimas Research Center on effects of fire on watersheds.

The hazard reduction and fuel modification studies called “Fuelbrake” and their application.

Research in human behavior aspects of fire prevention.

Preattack planning involving the construction and mapping of great nets of firebreaks, and facilities, and recording of knowledge needed should a fire start.

Organizing men and equipment for large fire control and interagency coordination.

The procession of new firefighting techniques that evolved from Operation Fire Stop—a most significant interagency effort.

The first use of a helicopter for firefighting and the adaption of techniques learned in the Forest Service smokejumper program to a subsequent fast attack, hard-hitting helitack program.

Major contributions in the use of air tankers and in chemical mixing and loading bases to support them.

Advances in the design and use of fire trucks, for mountain firefighting.

Development and use of mobile, power flamethrowers for backfiring.

Less spectacular, but very significant, studies that led to new land management direction.

In summary, southern California’s place in the Nation’s forest fire problem is an important and critical one—as a recipient of help from the rest of the Nation, and as a major contributor to fire problem solutions everywhere.

Whereas much progress has been made, there is a long way to go before we can feel we are not living too close to disaster.

All elements favoring fire are here, but so are all the elements we must look for for solution.

All agencies concerned are pulling together to a near unique degree. The disciplines of research and development are serving the men responsible for application.

Lastly, and most important of all, is public understanding and support. These elements combined are destined to solve southern California’s fire problem, and in doing so, to establish a lasting place in fire control pioneering.

Presented by Mr. Nelson at a fire meeting sponsored by California State Chamber of Commerce at Riverside, Calif., Sept. 11, 1963.

# LIGHTNING DAMAGE TO DOUGLAS-FIR TREES

ALAN R. TAYLOR, *Research Forester,  
Northern Forest Fire Laboratory*

Lightning causes more than 10,000 forest fires annually in the United States by igniting snags, live trees, grass, and duff. Field observations have long shown that the lightning may not ignite trees even though it damages them structurally. It is of interest to know why some fuels are ignited while others only receive various degrees of damage from lightning. The author started gathering background information on this problem by studying lightning-caused structural damage to trees that were not ignited. The study was conducted on a portion of the Deerlodge National Forest near Philipsburg, Mont.

About 1,000 lightning-damaged Douglas-fir trees were observed in the 10,000-acre survey. Detailed descriptions of damage were written for 53 of the most recently damaged trees. This note describes some of the special damage features.

## *Nature of Damage*

Visible damage to the 1,000 trees ranged from a superficial bark scar along the bole to nearly complete destruction of the tree. Figure 1 shows intermediate damage, with loss of top and a deep spiral scar where wood and bark were blasted from the tree. Most trees had shallow, continuous scars averaging 5 inches in width along their boles. About 25 percent of the 1,000 had two or more scars, 10 percent had severed tops, and about 1 percent had been reduced to slabs and slivers.

Damage was estimated for each of the 53 recently damaged trees by measuring scar width and depth at the 17-foot height on the bole. Lightning scars on Douglas-fir tend to be uniform in width and depth, except for slight taper, from about 10 feet above the ground to the upper end of the scar.

## *Scar Alinement*

The 53 observed scars were classed according to whether they were straight, oblique (tending to spiral, but making less than one revolution around the bole), or spiral. It is interesting that:

1. All scars followed the grain of the outer layers of wood.
2. Only 7 scars were classed as straight. Twenty-four were oblique, and 22 were spiral.
3. The straight scars were twice as wide as the oblique and spiral scars. Average widths were 10 inches, 5 inches, and 5 inches, respectively.

4. About one-half of the spiral scars ascended to the right, and one-half to the left. Trees with right-hand spirals averaged 260 years of age and those spiraling left averaged 140 years.

## *Scar Length*

Although lightning travels the entire distance between cloud and ground, lightning scars are seldom found along the entire length of a tree. The following points are noteworthy:

1. The average scar extended along 80 percent of the tree height.



Figure 1.—Douglas-fir showing loss of top and spiral scar with crack along its axis.

2. None of the observed scars extended to the tops of the trees. Distance between the upper end of the scar and tree tip ranged from 3 to 22 feet, with average distance of 10 feet.

3. One-half of the scars extended to ground level. The others reached to within 6 feet of the ground.

4. Upper ends of scars were not tapered to a point, as one might expect, but terminated squarely.

### *The Lightning Track*

Lightning sometimes leaves a narrow strip of inner-bark fibers along the middle of shallow bark-depth scars. This strip was observed on 12 of the 53 trees and usually ran the full length of the scar, adhering to the newly exposed wood surface. Scraping the shredded fibers away revealed a smooth shallow groove about  $\frac{1}{16}$ -inch wide. The groove was previously reported by McEachron,<sup>1</sup> who concluded that it marked the path of the discharge, which turned the wood along the path into gas.

Perhaps closely related to the groove is a narrow crack, found on 40 of the trees (fig. 1). The crack

1. occupied the same position as the bark strip and groove did on the other trees;

2. separated the two parallel slabs of wood that were blasted from the tree;

3. penetrated to the pith in some trees, as revealed by boring cores taken at right angles to the scar;

4. is a probable result of internal pressure created by the discharge current. It is frequently widened by exposure to the weather, but may eventually be closed or covered as the wound heals.

### *Bark-Loss and Wood-Loss Damage*

On 38 of the trees lightning removed only a narrow strip of bark; on the other 15 it gouged out deeper and wider furrows, causing loss of wood (fig. 2). From 12 of the wood-loss trees lightning blasted the wood in two parallel strips (fig. 2B), separated along the crack described above. Several trees lost considerable wood in this manner; for example, from one the lightning ripped a pair of straight slabs, each 8 inches wide, 3 inches thick, and 44 feet long.

Scar dimensions (see tabulation) were, on the average, greater on wood-loss trees than on bark-loss trees.

	Length (feet)	Width (inches)	Depth (inches)
Wood-loss trees-----	54	11	3
Bark-loss trees-----	46	4	1

Wood-loss trees measured in this study were usually older than bark-loss trees and usually of greater height and diameter. For reasons unknown, the larger, older trees apparently were more susceptible to wood-loss damage than the smaller, younger ones.

Based on the author's M.S. thesis, "Lightning Damage to Douglas-Fir Trees in Southwestern Montana," Montana State University, 1962. The study was financed by the U.S. Forest Service under cooperative agreement with Montana State University and the Northern Forest Fire Laboratory, Intermountain Forest and Range Experiment Station, from May 1961 to June 1962.

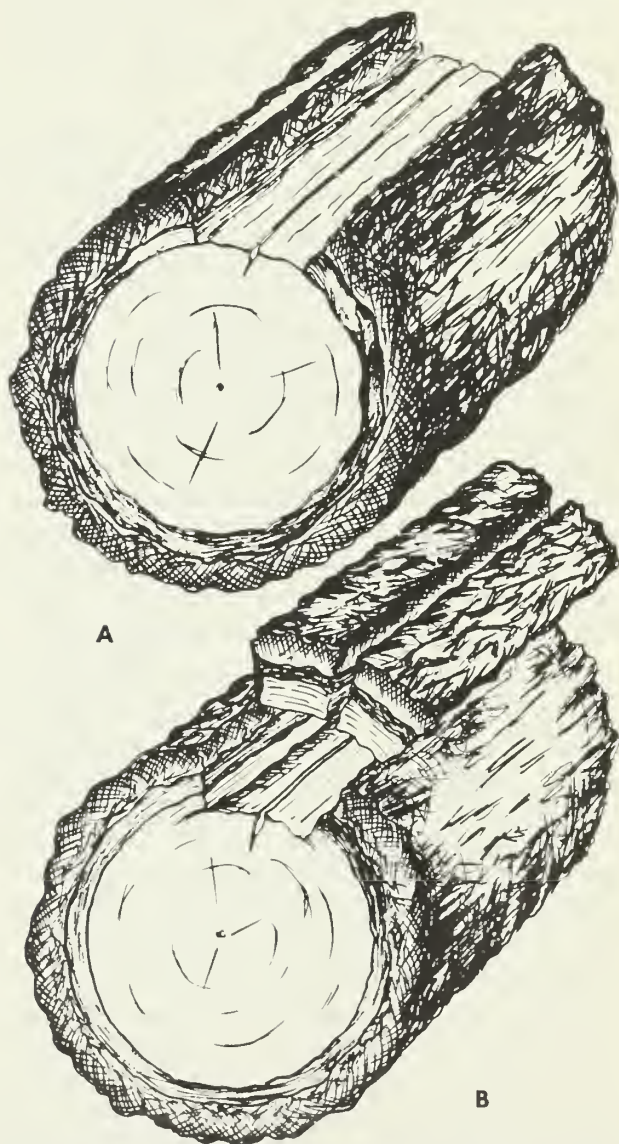


Figure 2.—A, Typical bark-loss scar; B, wood-loss scar, showing wood and bark removed in two slabs of nearly equal dimensions. Each hole has a crack along the scar axis.

<sup>1</sup> McEachron, K. B. *Playing with lightning*. 231 pp., illus. New York: Random House. 1940.

## **FIRE PREVENTION THAT WORKED**

JOSEPH COUCH, *Forester, Division of Fire Control  
Southern Region*

This article from the South affirms again the principle that specific problem identification in fire prevention is essential for productive results. It proves that effective fire prevention is not beyond the reach of the established field professional who can achieve the determined support of a community.

Although we've made progress in fire prevention nationwide, few of us are satisfied with the present level of knowledge and accomplishment. Who could be when, in 1962 for example, 94,000 man-caused fires burned almost 2 million acres of public and private forest lands under organized protection in the United States?

Experienced fire people know that the formidable number of variables and unknown factors involved in man-caused fires rules out categorical explanations for upward or downward trends. Nevertheless, some examples of successful prevention action may add valuable ideas to fire prevention work everywhere.

### **USE OF A SPECIALIST**

A Ranger District in the longleaf belt was beset by an intolerable annual rate of 193 man-caused fires per 100,000 acres protected. Of the 368 fires that the Ranger tallied for one calendar year, 342 were incendiary! The fires were being set for the usual reasons—such as improvement of open-range grazing; “opening the woods”; reduction of snakes, ticks, and other pests; resentment; ebullience while drunk.

#### ***People resent what they don't understand***

Careful analysis convinced the Ranger that his prevention program was only nibbling at the problem. The covert defiance of Forest Service authority to manage the land and the neglect of civic responsibility indicated the indifference and hostility often associated with misunderstanding. The Ranger concluded that more man-to-man contact—to increase mutual understanding between local residents and the Forest Service—would accomplish the most in the shortest time.

#### ***Finding the right man***

Although increasing the amount of contact work done, especially by himself, the Ranger also got authorization to set up a new Fire Prevention Aid position. The man hired was a natural for the job. A likable, rural personality, with the gray-templed dignity of late middle age, this man was a native of a neighboring county, a former sheriff, physically powerful, and unafraid of toughs singly or in groups.

After a period of training that qualified him to explain Forest Service programs, the new man went to work in the District's hottest spot. He didn't miss a single family. By getting acquainted with each adult and many of the children, showing movies and giving talks at the rural school, getting on a first-name basis with the preacher, school bus driver, grocer, and justice of the peace, he gradually built a bridge of understanding and personal regard. People began to ask him questions and to talk out their complaints instead of expressing them with matches. The Forest Service and the National Forest became something they understood.

### ***Understanding works both ways***

To the forest officers who'd been fighting the long strings of incendiary sets, backfiring plowed lines all night after a day's work on timber sales, wading around in fire and smoke all day Saturday and Sunday and every holiday when the forest was dry enough to burn, staking out on cold nights to catch a firebug, some of the residents had seemed like hardened criminals, to be dealt with harshly. However, the communication finally established with these people brought deeper understanding and a chance to further apply persuasion and salesmanship.

### ***Result***

By the end of the following spring fire season the worst hot spot was totally free of incendiary fires. Man-caused fires on the entire District were down 8 percent. Occurrence the following year was down to 81 man-caused fires, a figure which amazed all forest officers in the Region familiar with this District. Except for normal fluctuations this initial success was never lost.

### **REDUCING SIZE OF ADMINISTRATIVE UNIT**

To intensify management on a District plagued with an annual occurrence of 110 man-caused fires, the Forest Supervisor divided the unit and established a new ranger station in the town that was shopping center and county seat for the hotter localities.

The new office—handy for obtaining permits, buying timber, and hiring local men—increased community interest in the National Forest. The proximity of the hot spots allowed the new Ranger to give them personal attention, to get acquainted with the people, to study the fire problems in detail, and to devise specific measures against the heavy incendiary occurrence.

Following through, District personnel established a small lake and recreation area with the cooperation of county officials and worked with (1) the Extension Service—the County Agent, Home Demonstration Agent, Extension Forester—and the State forest service to create an annual forestry field day for rural adults and children alike, (2) stockmen's associations on grazing problems, and (3) farmers on safe methods of debris burning. Close surveillance in trespass-prone areas quickly turned up many violations. Firm, impartial law enforcement was applied to timber thefts, dishonest and erroneous land line surveys, land occupancy trespass, property damage, and intentional and accidental fire cases.

### **Result**

In 7 years, annual man-caused fire occurrence dropped from an average of over 100 to 19. The following year the total was eight. The occurrence level to date has stayed low.

### **INTENSIFIED LAW ENFORCEMENT**

On another District about 80 percent of the near 100 annual man-caused fires were incendiary. Concluding that the prevention program had successfully reached all residents whom his organization could teach or persuade, and that a small, hard core remained which would respond only to law enforcement, the Forest Supervisor brought in a Ranger who had had professional investigative training and experience.

Regular fire prevention activity was maintained, with emphasis on individual contacts. In addition planned personal acquaintance with possible witnesses and potential violators, before anything happened involving them, placed the new Ranger in an excellent position to cope with subsequent cases. While caution was exercised to avoid the appearance of persecution or of punishment and retribution rather than positive help, the Ranger nevertheless initiated a criminal or civil case for every fire on which sufficient evidence could be found.

### **Results**

The percentage of fires for which cases were initiated rose from 15 to 22 the first year, and at the end of 2 years stood at 54. During the above period man-caused fire occurrence dropped from 91 to 22 annually. Occurrence has remained low.

## **PERSONAL PERSUASION BY RANGER**

Man-caused fire occurrence had been averaging 40 fires annually, mostly from carelessness—in burning debris and in clearing thickets around residences without taking proper fire precautions. By visiting every land occupant prior to the fire season, the Ranger sold the idea of responsibility for guarding one's own burning, and taught safe methods of handling fire.

### **Results**

The next year ended with a total of three man-caused fires. Furthermore, the next 2 years were entirely fire-free!

## **THE CONFERENCE TABLE**

The change from steam locomotives to diesels on the major railroad lines in the Region during the 40's and 50's seemed to end the difficulty with right-of-way fires. The internal combustion engines of the new locomotives were not considered fire risks.

In 7 to 10 years, however, right-of-way fires began to reappear and multiply. Technical explanations pointed to aging equipment. As engine efficiency decreased, carbon accumulated in the exhaust stacks and was ejected as glowing flakes, sometimes as large as a quarter, when the engines labored under heavy loads or climbed steep grades. Attempts by some lines to economize by burning lower-quality fuel increased the carbon deposits, and heavier loadings of freight trains increased the ejections. Also, occasional fires were caused by hot brakeshoe slivers thrown off on steep downgrades or on curves.

To solve this problem by spark arrestors is not simple. Modifications which restrict free passage of exhaust gases tend to cut engine efficiency. The development and improvement of spark arrestors as well as braking systems has continued, but in the meantime the risk of a major railroad fire is ever present.

Cooperating with the State forest service, one Forest Supervisor arranged conferences with high officials of the major railroad traversing parts of his forest. He described the potential fire disaster, if right-of-way fires continued along inaccessible mountain grades, and the company's moral and legal responsibility to take preventive action.

The company's attitude was first skeptical and defensive. However, when a complete analysis of fire data, collected over a 10-year period for the area, was unveiled with maps, charts, and other visual aids, the railroad was convinced. They agreed to act.

The Forest Service and the State suggested that the company annually burn a protective strip along tracks in areas of high fire occurrence. They also offered to furnish technical advice and to help locate qualified men who might contract with the company to do the burning. The State offered to keep the contractors currently posted about the suitability of the weather. The fireproofing job began.

## Results

During the two fire seasons the operation has been in effect, no fires have occurred on the treated sections

of right-of-way—despite a particularly severe 1963 spring season. Company officials are convinced that much time, trouble, and money were saved by fire-proofing critical rights-of-way.

## CONCLUSIONS

Our records contain many other case histories in which aggressive, concentrated, prevention action cleared up bad fire occurrence situations. Taken together, the histories have convinced us that detailed study of a specific fire occurrence problem, careful prescription of approaches and remedies, and hard work in carrying out the plan will get real results.

## IMPROVED LUNCH FOR FIREFIGHTERS

EQUIPMENT DEVELOPMENT AND TESTING CENTER

*Missoula, Mont.*

Furnishing firefighters with enough food to sustain them during initial attack is a major problem in fire suppression planning. The usual sack lunch prepared for the field by local restaurants or mess halls and containing sandwiches, fresh fruit, canned juice or fruit, and candy bars has several disadvantages. Backlogs of lunch orders accumulate during severe outbreaks, and special trips are often made to send lunches after men have been dispatched. Sometimes there are long delays in deliveries and the lunches become stale and less palatable in transit. In some cases the lunches spoil, and firefighters have suffered severe cases of food poisoning.

The Missoula Equipment Development and Testing Center has started a project to provide a more satisfactory lunch. The primary objective is an improved sack lunch that can be prepared and stored at the beginning of the fire season and issued as needed. Other qualities sought for are (1) palatability, (2) enough calories to sustain a firefighter during initial attack, (3) readily obtainable items, (4) easy

preparation, (5) food that will remain safe and palatable for a reasonable time, and (6) a container that is easily carried and will not smash like regular sack lunches.

An experimental lunch meeting these qualifications is described in the figure and table. Since the typical firefighter expends approxi-

mately 400 calories per hour while fighting fire, the lunch (see table) should sustain him for 12 hours—about twice as long as would the old sack lunch. The carrying case permits firefighters to pack the lunch in comfort, leaving both hands free.

Although the lunches can be refrigerated (not frozen) to extend



### Components of firefighters' lunch with box and carrying case.

shelf life, the packing date should be plainly marked on each. At the end of the fire season lunches should be unpacked and items that are ap-

proaching their recommended shelf life should be discarded or eaten.

An initial supply of 1,200 experimental lunches was well received by

firefighters and used up early in the 1963 fire season. Final specifications will be prepared after firefighters return their questionnaires.

### Firefighters' lunch, menu 1

Food item	Package	Weight	Calories	Approximate price per package	Estimated shelf life		
					40° F.	70° F.	90° F.
		oz.			Months	Months	Months
Cheese and crackers	Plastic (2)	1½	296	\$0. 05	6-12	6-12	6-12
Hot cocoa mix	Plastic (1)	1	80	. 05	60	24	12
Spaghetti with cheese	Can (1)	6½	750	. 08	48	36	24
Jam, assorted	Plastic (6)	3	164	. 08	48	18	10
Catsup	Foil (2)	1	27	. 02	48	24	12
Mustard	Foil (2)	1	4	. 02	36	18	9
Raisins	Box (2)	3	233	. 08	24	12-15	6-9
Caramels, vanilla and chocolate	Cellophane (2)	2	296	. 08	12	9	4
Deviled ham	Can (1)	2¼	250	. 15	60	48	30
Pears	Can (1)	9	173	. 16	48	24	12
Beef goulash	Can (1)	8	320	. 15	60	48	30
Sardines	Can (1)	4	384	. 19	48	12-24	6-12
Cookies	Cellophane (4)	3	375	. 15	48	24	12
Bread, brown	Can (1)	16	1, 289	. 29	48	24	12
Totals		4 lbs.	4, 641	<sup>1</sup> 1. 88			

<sup>1</sup> Actual cost of 1,200 units for field testing: \$1.56 each, including accessory packet and fiberboard box. Canvas carrying case costs \$1.62. A more economical carrying method is being devised.

## A TECHNIQUE IN TOWER ORIENTATION

JAMES E. MIXON

*State Forester, Louisiana Forestry Commission*

Obtaining accurate cross outs on fires has presented a problem since the early days of fire detection. Several things can contribute to inaccurate cross outs of fires. One is the incorrect orientation of the fire tower from using the wrong magnetic declination for its longitude. Another is any error in the preparation of the cross out or district maps. However, since the same map with its errors is common to all towers within a parish and district, the greatest contributor to error is the difference between the azimuth circle of the tower table and those of the cross out maps.

To eliminate these causes of error, the Louisiana Forestry Commission has devised and instigated a program of tower orientation by districts. The program, by chain reaction, will result in correlation of all towers of the State. A brief explanation follows.

From the tower cross out map for the parish a known point, such as a section corner or a road intersection, is selected between two or more towers. From this point a balloon 6 feet in diameter, filled with a mixture

of air and helium, is released. It is controlled from the ground by a light nylon line and allowed to rise to a height of from 200 to 300 feet. Because of its yellow or orange color it can be detected from 5 to 7 miles away, depending upon weather and keenness of sight. The towerman is told of its approximate location by radio and asked to get a reading on it. The cross out readings from the towers have previously been recorded by the orientation crew. When tower alidade readings have been reported, any difference between the alidade reading and the map cross out reading is readily noted; and the table azimuth circle can be corrected to coincide with the cross out map azimuth circle.

When the difference is sufficient, correction is made by having the towerman take another close reading and pinpoint or mark the point of his alidade just off the edge of his table azimuth circle. He then loosens the screws of the azimuth circle and rotates it to make the reading coincide with that of the cross out map.

## PAPER PACKAGING FOR AIRDROPS

DIVISION OF FIRE CONTROL  
*U.S. Forest Service*

Smokejumper Dale A. Crane, working on the Carabou Ridge Fire on the St. Joe National Forest, reported an unexpected result of an airdrop malfunction. A power saw dropped by parachute broke loose when a cargo ring failed during opening shock. The free-falling package hit a 15-foot western larch, removing all the branches from one side prior to impact with the ground. Expecting the worst, Crane retrieved the package and found the power saw intact with no damage to accessories. Oil and gas cans had not ruptured.

Luckily the box landed right side up and the honeycomb paper absorbed the free fall impact.

The saw was packed in a multiwall fiberboard box and protected with paper honeycomb cushions. Similar parachute failures in the past have resulted in complete loss of the saw, fuel, and accessories. The fiberboard container for this saw was developed by the Missoula Equipment Development and Testing Center under a special project to explore the use of low-cost energy-absorbing materials for protective packaging of

cargo. In this instance a \$2 box saved a \$350 piece of equipment. Usually power saws are packaged in comparatively expensive handmade, heavy, cleated wood boxes. The latter weigh more than the saw and are frequently damaged beyond repair.

A report from cargo droppers at the Redding Air Attack Base in northern California states that a single experimental fiberboard box of the same type has been used five times in dropping power saws to fires; however, the parachute opened on each drop.



Box and honeycomb cushion for airdropped powersaw.

## THE LARGE TANKER—EXTENDING ITS USE

JOHN A. ANGUILM, *Assistant Regional Supervisor, Region 1*  
*Michigan Department of Conservation*

The large water tanker, primarily used to supply smaller units on the fireline, can serve an additional purpose if equipped with a simple water boom and adequate pump.

In 1962 Al Jackovich, Region 1 mechanic, fabricated such a water boom assembly on our 2,000-gallon semi-trailer tank unit. The purpose of this addition to the

normal uses of a large tanker is to permit application of a large volume of water quickly to a planned control line in the path of a fire.

Fire behavior studies, field experience, and table-model demonstrations have shown that even minor variations in temperature and humidity have a surprisingly great effect on fire ignition and movement.

**Water-dispensing boom mounted on 2,000-gallon tanker** (photo courtesy of Michigan Department of Conservation)



This understanding triggered a method of creating, along a control line, a microclimate that might bring crown fires out of the treetops. Then effective attack with conventional control equipment would be possible.

In situations where advance deployment of forces can be made, some lessening of the intensity of the fire head may result even when complete success is not achieved.

Crown fires moving in natural or planted stands of red, white, and jack pine constitute an immediate and growing fire control problem in the Lake States. Openings of 50 to 150 feet wide provided by roadways, power lines, and fire lanes provide little hindrance to progress of such fires if the cover burns to the border of the opening. Flaming brands of cones and branches blow freely across the open; updrafts carry burning materials for substantial distances across the openings. Many of these brands rise vertically from intensely burning fuels and are carried aloft and over the tops; however, many more are cast horizontally and only short distances.

Using components on hand, a 200-g.p.m. pump powered by an 80-hp. industrial motor was installed. The boom was fashioned from 2-inch black pipe, and nozzles were attached with orifices of  $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{1}{2}$ , and  $\frac{5}{8}$  inch from bottom to top. In position, the boom reaches 22 feet above ground and provides an even water coverage to a depth of 80 feet against a light wind. Facing a strong wind, the water breaks into a mist and approximately 50 percent drifts downwind across the line of travel, resulting in lesser coverage in the direction of discharge. The tank capacity (2,000 gal.) is dispensed in 12 minutes at a rate of 170 g.p.m. through the four nozzles. Experience indicates effective coverage can be gained over 140 rods of control line at vehicle speeds of 2 to 3 m.p.h.

Experiments to date with the described unit encourage us to seek more maneuverable vehicles with enough water capacity for effective water applications to openings other than roadways. Heavy-duty, multidrive vehicles available from time to time from the Federal Excess Program provide opportunities heretofore unavailable for such developments.

We believe such efforts offer a good chance of success under conditions less than extreme, and on areas where the stand is without firebrand material of the white birch and hemlock stub fuel variety.

## SUMMARY OF FIRE LOSSES IN ALASKA

BUREAU OF LAND MANAGEMENT  
U.S. Department of the Interior  
Anchorage, Alaska

Year	No. of fires	Acreage burned
1946 -----	130	1, 436, 597
1947 -----	159	1, 429, 896
1948 -----	134	33, 676
1949 -----	53	17, 933
1950 -----	224	2, 057, 817
1951 -----	271	219, 694
1952 -----	136	73, 801
1953 -----	285	466, 748
1954 -----	262	1, 389, 920
1955 -----	190	23, 582
1956 -----	225	467, 721
1957 -----	403	5, 034, 554
1958 -----	196	288, 616
1959 -----	286	586, 535
1960 -----	157	85, 240
1961 -----	116	5, 440
1962 -----	102	38, 923
Total -----	3, 329	13, 656, 693
Average ---	191	815, 094

Since 1940, the Bureau of Land Management has been responsible for protecting 225 million acres of public land from forest, range, and tundra fires in Alaska. This area now includes the 8 million acres recently selected by the State of Alaska.

There are no lookout towers in Alaska—and very few roads, bulldozers and fire trucks. Here, firefighting is mostly a job for aircraft and men on foot. Vast distances, long hours of daylight, high temperatures, dry fuels, frequent lightning strikes, bad terrain, limited equipment and manpower, all combine to make BLM's task of protecting the public lands from fire one of the toughest assignments of its kind in the United States.

### FIRE CONTROL NOTES

Information for those who bind Fire Control Notes: A cumulative index for the period January 1956 through October 1963 will be printed in the old style size and format and distributed to subscribers in the near future.

# REPORT ON AERIAL FIRE DETECTION STUDY

LOUIS L. DAVIS

*Forester, Ouachita National Forest*

Early in fiscal year 1963, the Ouachita began investigating the possibility of establishing a ground-air detection system. The present system consists of 26 primary and secondary lookouts on a gross area of 2,541,000 acres of which 1,543,413 acres are National Forest land.

Several factors prompted the investigation:

1. The topography makes ground detection difficult. In spite of the large number of towers 22 percent of the area remains unseen. This is due to the system of long narrow ridges, uniform in height, with few prominences high enough to overlook adjoining ridges. Many towers would be necessary to adequately cover the protected area.

2. Public use of the forest is booming and the corresponding risk increasing. Land values, already high, are increasing.

3. Each year it becomes more difficult to find competent men to replace the lookouts that are retiring, and costs of training and actual manning are high.

4. Maintenance of lookout towers is expensive, and most of the towers need rehabilitation to bring them to standard.

## **Study Plan**

It was decided to make a study before coming to a decision. Past records were researched and a study plan made. The object of the study was to determine (1) if air patrol could effectively eliminate enough tower manning to be economically practical and (2) the effect on control time standards. The following organization was used: dispatcher, observer, communications technician, and pilot. The study was to be carried out for 1 year on approximately 1 million acres of the east part of the Ouachita National Forest.

## **Operations**

The study occurred during the second year of drought. Fire occurrence in 1962 was twice that of 1961, and the trend continued through the period. Rainfall was approximately one-half of normal for the period and the previous 4 months. Chances to fly on low danger days in lieu of primary tower manning did not materialize. Due to high buildup primaries were manned on all class 2 days. The plan became active on January 10, 1963, with the letting of a contract for rental of aircraft and pilot based at Hot Springs, Ark.

From March 13, after preliminary flights to determine patrol routes and time required, to June 30, 1963, 85 flights were made on 66 days. Altitudes varied from 1,500 to 2,500 feet above terrain. Two flights were cancelled on notice from FAA of extreme turbulence, and two were cancelled because of low ceilings. Almost all flights encountered low to moderate turbulence, but none were aborted due to airsickness. Visibility from the towers was poor during most of the period. Visibility from the air proved better from just above the haze layer than at lower elevations.

Smokes were scouted from as low an altitude as considered safe by the pilot. Forty-four smokes that probably would have required false alarm runs by ground personnel were checked out. In fact, no false alarm runs were made while the observer was airborne. This was important to rangers, as they were engaged in APW work with deadlines to meet.

Residents soon learned that any burning they started would be checked closely from the air. Observer and pilot made three reports of circling unattended meadow fires until the farmer came and waved them on. This year the number of land clearing and meadow fires in the patrol area is less.

## **Results**

Results thus far indicate that one plane with skilled pilot and observer and 5 lookout towers provide better detection at reduced cost than an all-ground system of 14 towers. Additional, uncalculated savings result from prompt scouting and reduced attack and control time through accurate location with nearest access route. Significantly, the largest of 74 fires in the patrol area burned 177 acres. On the other half of the forest there were several class E fires during the same period.

### *Air operations*

Days flown-----	66
Flight totals:	
Number -----	85
Hours -----	254
Fires detected:	
In flight-----	<sup>1</sup> 24
By lookout and others-----	57
False alarms checked in flight-----	44

<sup>1</sup>Includes seven State and Corps of Engineer fires.

AERIAL STUDY—Continued

Supplementary Data

*Air unit operating costs*

Airplane and pilot. . . . .	\$4,089.33
Observer. . . . .	1,324.13
Radio technician. . . . .	68.00
Mileage. . . . .	373.61
Total. . . . .	\$5,855.07

*Lookout costs*

Primary. . . . .	\$5,389.41
Secondary. . . . .	54.20
Total. . . . .	\$5,443.61

*Estimated savings*

9 secondary towers, not manned, 42 days. . . . .	\$4,868.00
Travel, 30 miles per tower per day. . . . .	1,134.00
Communications maintenance, 9 towers, 2 trips each <sup>1</sup> . . . . .	288.00
Inspection, training, and supervision; \$37 each. . . . .	333.00
6 months maintenance. . . . .	300.00
44 false alarms. . . . .	1,100.00
Total. . . . .	\$8,023.00
Less air unit cost. . . . .	5,855.07
Net savings. . . . .	\$2,167.93

<sup>1</sup> Includes only such mileage as could be estimated from regular schedule. No special trips from base. No dollar value is given for scouting, guiding crews, etc.

TABLE 1.—Number of fires and fire days by class of day  
[March 13–June 30, 1963]

Time of origin	Fires Class of day—					Total
	1	2	3	4	5	
0001–0800. . . . .	2	1	4	4	1	12
0801–1000. . . . .	1	1	1	3	2	8
1001–1200. . . . .	1	1	4	7	0	13
1201–1400. . . . .	0	0	3	3	0	6
1401–1600. . . . .	1	0	2	0	2	5
1601–1800. . . . .	1	1	2	5	2	11
1801–2000. . . . .	0	1	2	4	0	7
2001–2400. . . . .	0	0	4	4	4	12
Total fires. . . . .	6	5	22	30	11	74
Total fire days. . . . .	30	32	26	17	5	110

*Number of fires by size class and cause*

Size class:

A. . . . .	7
B. . . . .	41
C. . . . .	23
D. . . . .	3
E. . . . .	0

Cause:

Lightning. . . . .	14
Recreation. . . . .	4
Smoking. . . . .	6
Land occupancy. . . . .	6
Incendiary. . . . .	42
Forest utilization. . . . .	1
Miscellaneous. . . . .	1

Reserve

April 1964

Vol. 25, No. 2

766Fi

# FIRE CONTROL NOTES

U. S. DEPT. OF AGRICULTURE  
NATIONAL AGRICULTURAL LIBRARY

MAY 18 1964

CURRENT SERIAL RECORDS

U.S. Department of Agriculture  
Forest Service



# FIRE CONTROL NOTES



*A quarterly periodical devoted to forest fire control*

## CONTENTS

<i>Page</i>		<i>Page</i>	
3	Effect of overstory on ground distribution of airdropped slurries RAGNAR W. JOHANSEN	9	The Forest Service specification program for fire equipment CARL BURGTORF
5	Aerial survey of tower sites C. F. PLATT	11	Fire hazard on Tobago MERRILL E. TESTER
7	Fire retardant for ground attack R. M. COY	13	Fire hazard management JOHN MORRISON
8	Use of air pressure powered water tanks in west Tennessee MICHAEL H. STANFORD		

## INFORMATION FOR CONTRIBUTORS

Please submit contributions through appropriate channels to Director, Division of Fire Control, Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250. Articles should be typed in duplicate, double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and organization.

Authors are encouraged to include illustrations with their copy. Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints or India ink line drawings are acceptable. Captions for illustrations should be typed in the manu-

script immediately following the paragraph in which the illustration is first mentioned, the caption being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the caption to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

COVER—TBM air tanker making drop in open test area. (Photo courtesy of Monsanto Chemical Company)

FIRE CONTROL NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D.C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. Use of funds for printing this publication approved by the Director

of the Bureau of the Budget (Sept. 16, 1963).

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, 20 cents a copy, or by subscription at the rate of 75 cents per year, domestic, or \$1.00, foreign. Postage stamps will not be accepted in payment.

# EFFECT OF OVERSTORY ON GROUND DISTRIBUTION OF AIRDROPPED SLURRIES

RAGNAR W. JOHANSEN, *Research Forester,*  
*Southern Forest Fire Laboratory*

Overstory crowns and understory vegetation affect the success of an aerial retardant drop by intercepting much of the material before it reaches the ground. Miller and Reinecker<sup>1</sup> reported there was considerable interception of dropped retardant slurries by heavy brush and timber canopies in California. In Georgia,<sup>2</sup> pine canopies with closures ranging 63–69 percent in stands 25–55 feet in height intercepted 40 percent of the kaolin slurries released from a TBM air tanker owned by the Georgia Forestry Commission. Therefore, to obtain desired ground coverage, more material had to be dropped into a fairly heavy pine canopy than in open areas.

Further tests were deemed necessary to acquire a quantitative estimate of retardant interception by different types of vegetative cover. In a mature bottomland hardwood stand 90 feet tall, located on the Oconee National Forest in Georgia, drops were first made while the trees were in full leaf and again when they were bare. Results from these tests were compared with data obtained from drops into a 22-year-old, 15 by 15-foot spaced slash pine plantation 60 feet tall on the George Walton Experimental Forest, near Cordele, Ga. Crown closure exceeded 60 percent in all of the forested areas. For comparison, drops were also made in the open.

Dropping procedure was standardized as much as possible to minimize sampling error. Only 220- and 440-gallon loads were used; airspeed at time of drop ranged 100–110 knots; and altitude was maintained 75–90 feet above the highest obstruction.

Former studies have shown that large tank gates and quick release are best. Thus, when the pilot trips the tank latch, he virtually opens the bottom of the tank. This produces an elliptical ground pattern concentrated at the center and tapering off to

the sides and ends. By effective pattern length, we mean end and side limits of one-half gallon per 100 square feet, or in certain heavier fuels 1 gallon per 100 square feet—which are considered minimum for extinguishing fires in the Southeast.

To align the air tanker with the drop area and to designate the proper drop altitude, helium-filled weather balloons were raised in a prearranged pattern immediately prior to each test (fig. 1). Plastic ½-gallon cups spaced 20 feet apart in rows 25 feet apart were used to make a ground grid covering an area 150 by 500 feet. Slurry in the cups after a drop gave us an estimate of amounts and distribution on the ground.

Results from this study (table 1) indicate that for drops over open areas (see cover) 220-gallon loads are almost equal in effectiveness to 440-gallon loads, provided ½- to 1-gallon application rates are adequate to stop a fire. Either drop load will generally result in an effective line at least 200 feet long.

Where fairly heavy pine canopies exist in the Southeast, drops in excess of 220 gallons are needed to produce a 200-foot line at the minimum required application rate of one-half gallon per 100 square feet.

Only 78–79 percent of the slurry dropped over open areas could be accounted for. The remaining

Figure 1.—TBM air tanker lining up with helium-filled balloons that mark the test drop area.

<sup>1</sup>Miller, H. R., and Reinecker, H. P. Air tanker report, California, 1957. U.S. Forest Serv., Fire Control Notes 19: 53–56, illus. 1958.

<sup>2</sup>Storey, T. G., Wendel, G. W., and Altobellis, A. T. Testing the TBM aerial tanker in the Southeast. U.S. Forest Serv., Southeast. Forest Expt. Sta. Paper 101, 25 pp., illus. 1959.

TABLE 1.—*Relation of drop load<sup>1</sup> to length of slurry pattern in open and forested areas*

Drop type and number	Pattern length at:		Slurry reaching grid
	$\frac{1}{2}$ gal./100 sq. ft.	1 gal./100 sq. ft.	
	<i>Feet</i>	<i>Feet</i>	<i>Percent</i>
220-gallon, open			
1 .....	240	200	85
2 .....	280	240	74
3 .....	180	180	75
Average .....	233	207	78
440-gallon, open			
1 .....	260	260	83
2 .....	200	180	73
3 .....	280	280	82
Average .....	247	240	79
220-gallon, pine forest			
1 .....	120	100	54
2 .....	180	120	39
3 .....	140	120	52
Average .....	147	113	48
440-gallon, pine forest			
1 .....	220	220	42
2 .....	240	160	54
Average .....	230	190	48
220-gallon, full hardwood canopy			
1 .....	25	0	9
2 .....	25	25	11
Average .....	25	12	10
440-gallon, full hardwood canopy			
1 .....	0	0	17
2 .....	50	50	10
Average .....	25	25	14
220-gallon, bare hardwood canopy			
1 .....	260	(2)	(2)

<sup>1</sup>Kaolin slurries were used to simulate thickened retardant mixtures.

<sup>2</sup>Too much of the slurry load fell outside cup pattern to permit this computation.

material (21–22 percent) was apparently lost from the drift of very fine particles out of the drop area. When drops were made over pine canopies, only 48 percent of the slurry could be accounted for on the ground underneath. This indicates that the canopy intercepted about 30 percent of the dropped material.

The penetration of 220- and 440-gallon kaolin slurry drops through a mature, well-stocked, fully leafed hardwood stand was extremely poor compared with the amount of material striking ground fuels from drops made over open areas. The 10–15

percent of material that did reach the grid area was concentrated under canopy openings. Because of the high interception rate, the longest line made in the fully leafed hardwood drop series with application rates exceeding one-half gallon per 100 square feet was 50 feet.

During the winter, two 220-gallon drops were made over the previously used bottomland hardwood canopy. Although neither drop fell completely within the confines of the measuring grid, enough data were usable to indicate that the bare

*Continued on page 15*

## AERIAL SURVEY OF TOWER SITES

C. F. PLATT, Assistant Senior Superintendent,  
Forest Protection Branch, Alberta Forest Service

An aerial survey program for the selection of forestry tower and lookout sites in Alberta was begun in 1956. Its characteristics were dictated by the following factors:

1. The rate of expansion in Alberta's forest service demanded that a large number of sites be established within a relatively short period of time.

2. Complete topographic and contour mapping was unavailable.

3. Large areas and great distances were involved (forestry administration covered more than 142,000 square miles at the time, the majority being boreal region).

4. The need for a consistent standard in lookout site evaluation required a single, simplified site selection routine.

The final method adopted was a combination of earlier procedures and new methods suited to the territory and topography involved.

### Preliminary Survey

*Objective.*—To select a large number of heights of land for possible tower sites for further evaluation and final selection.

*Method.*—Fly a series of grid flights by fixed-wing aircraft, at 1,000 feet above ground level, on grid lines spaced at 12-mile intervals. The altitude is specified to provide the airborne selector with topographic definition; at higher altitudes ground contours begin to flatten out. Visual comparison of heights of land are made in flight and locations plotted.

By this means large areas are quickly appraised, and the most likely sites plotted to simplify final

selection surveys. Preliminary surveys should be conducted well ahead of actual lookout construction planning. A 2-year interval and backlog of possibilities are considered adequate.

### Final Survey

*Objective.*—Selection of a final construction site, within a specific region, from among possible sites plotted on preliminary surveys.

*Method.*—A helicopter flight is made directly to the plotted sites in the area. Each is evaluated in turn and the final selection marked from the air by dropping two rolls of red plastic marking ribbon; one roll for air location is laid along the tree canopy, and one for ground location is allowed to drop through the canopy to the ground. Following selection, a series of horizontal photographs are taken from the aircraft, at approximately tower cupola height above the selected site (fig. 1). The photographs provide "seen" area illustration through a complete circuit made at the point of location. Film is exposed at intervals based on time of complete circuit divided by 16 (the number of exposures required by camera

lens angle to give proper exposure overlap).

Oblique photographs are then taken from an altitude of approximately 4,000 feet above ground. These illustrate the overall site, viewed from several directions, and include landmark tie points for future location references (fig. 2).

Timber stand heights and estimates of required site improvements, access routes, and specific ground survey needs are noted during final survey flight.

Following final survey, photographs are interpreted by a photogrammetrist who plots "seen" areas on a map. Areas of doubt may be checked by ground survey and engineering opinions sought before any final construction program is laid on.

### Equipment

*Fleet helio courier airplane.*—260-hp. Lycoming motor,<sup>1</sup> model GO-435-2C. Flight characteris-

<sup>1</sup>The identification of commercial products is solely for information purposes and does not imply endorsement by the Forest Service, U.S. Department of Agriculture.

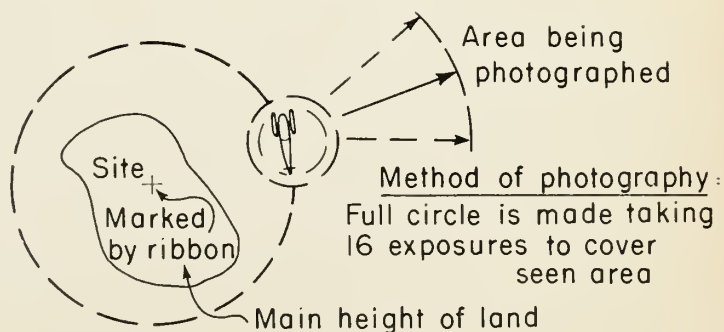


Figure 1

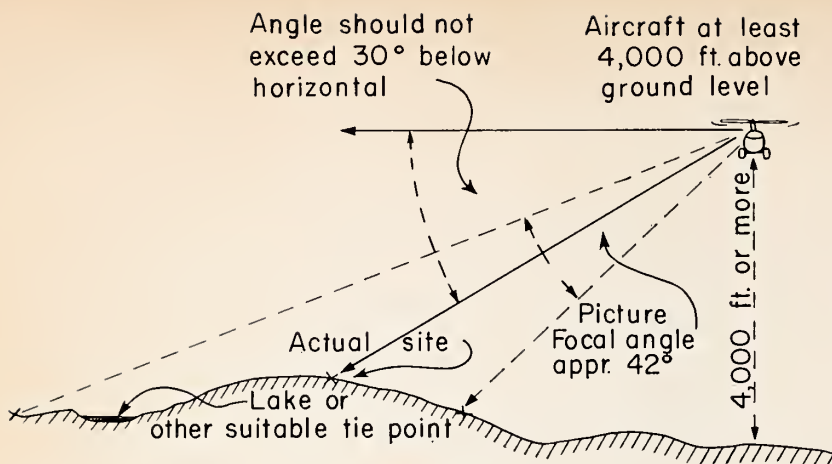


Figure 2

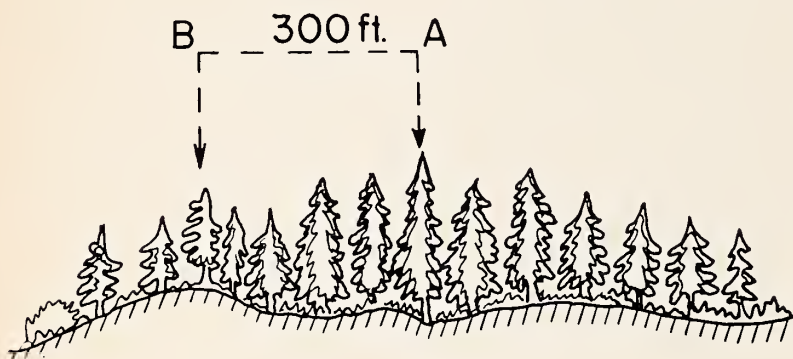


Figure 3

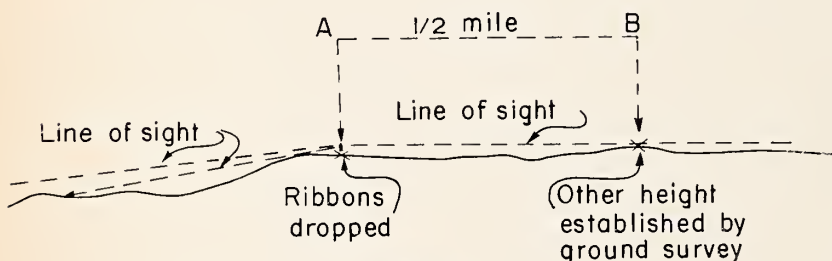


Figure 4

tics: slow speed, short takeoff and landing distances.

*Bell 47J2 helicopter.*—305-hp. Lycoming motor, model VO-435-A1B. Flight characteristics: service ceiling 12,000 feet with load of 1,000 pounds.

*Fairchild K20 hand-held aerial camera.*—Lens: f4.5, 161-mm., focal length 6 $\frac{3}{4}$  inches. Filters:

minus blue written 12 combined with haze #1, series 6. Film: modified infrared aerographic roll type, 50 exposures per roll, exposure index 100. Light meter.

#### Problems

Timber heights may vary at a site summit, and in such cases ground-level checks should be used for a final decision (fig. 3).

Plateau-type sites should be checked carefully for land shoulders that may seriously reduce the total "seen" area from this location (fig. 4).

Helicopters are used for final site selection because of their safety factor. However, helicopters lack some of the lateral flight stability featured in fixed-wing aircraft maneuvers, and constant correction of camera angle is required during circuit if winds are encountered.

Film selection is important if haze and variations in light and shadow are to be surmounted, particularly in "seen" area exposures. The film used in Alberta is reasonably satisfactory; however, cloudless days should be selected for photography, if possible. Broken cumulus imposes heavy black shadows on landscape which may limit photogrammetry. Vibration through helicopter rotor blade flutter requires shutter speeds of over 1/250 of a second; good lighting is essential for quality results.

#### Checklist

An observer may find a survey data sheet useful to almost eliminate the need for writing during flight and to provide checkoff reference for future observations. Suggested references for such a checklist are:

Location, date, weather, hour of photography, camera settings and meter readings, camera filters, type of film, number of exposures and shutter speed, orientation points (lakes, streams, etc.), landing possibilities, land access routes, height of tower required, altitude of site, and (in writing) miscellaneous characteristics.

## **FIRE RETARDANT FOR GROUND ATTACK**

R. M. COY, *Forester,*

*Pennsylvania Department of Forests and Waters*

Much has been written in recent years about the use of various retardants in fighting forest fires. Most of the work and use of retardants has been with air attack as a support action to ground attack.

The air attack arm of the Division of Protection, Pennsylvania Department of Forests and Waters, has been developing into an essential attack unit in the control of forest fires. Its successes or failures have been tied to the presence or not of direct ground attack on the fire within minutes of airdrops. For the most part, the ground action has been by "smokechaser" crews.

The smokechaser crews are not new to Pennsylvania. For 20 years or more they have been an extremely important part of the control organization in the anthracite coal region of eastern Pennsylvania. The theme of their operation has been "Hit 'em quick, your next fire may have already started." These crews generally consist of two men supplied with a small pumper unit of 100-gallon tank capacity, a live reel with several hundred feet of  $\frac{3}{4}$ -inch booster hose, fuses, assorted small handtools, mobile radio, and transportation suitable to carry all this into rough country. Once at the fire, their main attack tool has been the 5-gallon backpack tank.

The accomplishments with this 5-gallon tank by one who knows how to use it and has faith in his ability are amazing; yet no one has been more conscious of the limitations of this attack system. In the search for the "equalizer," experience has proved that laying fire hose for more than short distances is not a practical solution because of the nature of forest cover, topography, and water supplies. Rather, attention has been focused on any material that, as an additive to water or in pure form, could increase the effectiveness of the backpack tank. Many such materials have been tested, but none has had wide acceptance.

One material which might be the "equalizer" is Pyro 11-37-0,<sup>1</sup> manufactured as a commercial liq-

uid fertilizer by TVA but also marketed as a fire retardant.

Six thousand gallons of Pyro were purchased for the spring fire season of 1963 to be used by air-attack and ground crews. The initial results brought approving reports.

The manufacturer recommended a mixing ratio of 5 parts water to 1 part Pyro, and we have attempted to maintain an approximate 5 to 1 mix for our airdrops. However, I have witnessed a series of successful airdrops by a helicopter (100-gallon drops) in which ratios of 5 to 1 and 10 to 1 were used indiscriminately with no apparent difference in effect. Ground crews have been using a 10 to 1 ratio in their backpack tanks with results apparently equal to stronger mixes.

At this time the most effective method of attack by ground crews equipped with backpack tanks seems to be a direct one of playing a narrow spray of the mixture to the base of the flame and directly ahead of it. When intensity of the fire is such that men cannot approach for a direct attack, a line several feet in width has been sprayed a safe distance in front of the fire. This has sufficiently slowed the fires to allow men to move in for direct attack. Back fires have been allowed to burn out against retardant lines and occasionally have burned under the retardant lines. Motorized pumper units using 10:1 mixtures have been successful in establishing lines for indirect control, owing to the greater volume discharge and the greater width of the resulting line. No major problem in equipment maintenance has developed from the use of this retardant.

Some of the characteristics of Pyro and possible solutions to some of the problems encountered in its use are:

1. May cause "fertilizer burn" to living plants. This has never been found on forest vegetation, but has been disastrous on lawn grass.
2. Nontoxic to humans or animals.
3. Excessive contact with skin has caused slight dermatitis, although Pyro is easily rinsed or washed away.

<sup>1</sup>Pyro is made of the following components: 49 percent ammonium phosphate, 28 percent ortho phosphate, 17 percent tripoly phosphate and 6 percent other (primarily tetrapoly phosphate).

*Continued on page 15*

## USE OF AIR PRESSURE POWERED WATER TANKS IN WEST TENNESSEE

MICHAEL H. STANFORD, *Assistant District Forester,  
Tennessee Department of Conservation, Forestry Division*

Because of easy access to fires, owing to an extensive road net and flat terrain, water can be used extensively in direct fire suppression in west Tennessee. Because of budget limitations the required number of commercial slip-on pumper units could not be purchased, so a cheaper method of getting water to the fire was looked for.

The answer is a 30–60-gallon pressure tank fitted with an air gage, air valve stem, a 2-inch filler hole, 500–100 feet of  $\frac{5}{8}$ -inch rubber hose and a nozzle (see figs.).

The tank is filled to the  $\frac{3}{4}$ -level with water, with or without fire retardant or wetting agent added, and 100–150 p.s.i. of compressed air is put into the tank, the amount depending on the pressure capacity of the tank. Hot water heater tanks, for example, have a pressure capacity of 125 p.s.i.

Two kinds of nozzle have been tested, a regular garden hose nozzle and a low-volume, fog-type crop spray nozzle. A 40-gallon tank at 100 p.s.i. will spray an effective stream for approximately 45

*Continued on page 16*

Figure 1.—Forty-gallon air pressure water tank mounted in rear of station wagon.



# THE FOREST SERVICE SPECIFICATION PROGRAM FOR FIRE EQUIPMENT

CARL BURGTORF, *Forester,*  
*Division of Fire Control*

Firefighters need and expect good performance from the fire equipment and supplies they use on firelines. Fire equipment must be dependable, and safe to use.

In the early days firefighting Rangers learned to select certain brands of fire tools which experience had shown would meet their exacting requirements. Many of the tools were handpicked and maintained or sharpened by the men who used them. Today, fire equipment may be purchased in large quantities by a procurement officer with only a written description and specification for guidance. However, the objective of the program is to continue to meet the exacting needs of the firefighter. The procedure is different, but the field still has a voice in the development of specifications for fire equipment.

At one time the Forest Service maintained warehouses stocked with fire equipment and supplies. In 1956 the Forest Service signed an agreement with the General Services Administration which provided for procurement and stocking of fire equipment and supplies by the Federal Supply Service. While this gradually reduced the Forest Service Warehouse stocking of fire items, the Forest Service has the responsibility to provide GSA with suitable specifications for the equipment and supplies needed for fire control activities. It is especially necessary to develop specifications for all new items of fire equipment as they come into use.

## *Forest Service Specifications*

The Forest Service specification is a technical detailed description of a material, product, or service. Inspection and testing procedures, performance requirements, preservation needs, packaging and packing instructions are usually included in the specification. The end purpose of the specification is primarily to meet the needs of the user by providing fire equipment of uniformly acceptable quality. Several steps are necessary to accomplish this.

First, use of the equipment is examined, and the field is canvassed to determine if a specification is

needed. Comments are invited from field people in determining requirements for the item being considered. When needs are known, a search is made to find commercial products that are on the market. These are examined by engineering or equipment specialists who choose special qualities and devise testing and inspection procedures to include in the final specification.

Next, a proposed specification is written and circulated to field units, to interested suppliers, and to industry for review and suggestions. This information is carefully weighed and often results in desirable corrections to the proposed draft. This work is usually done at the Forest Service Equipment Development and Testing Centers located at Arcadia, Calif. and Missoula, Mont., or at the Electronics Center at Beltsville, Md.

The Division of Fire Control reviews and coordinates preparation, processing, and distribution of fire equipment specifications. After review and acceptance by the Division of Fire Control, the specification is usually printed initially as an Interim Specification and remains in use for 1 or 2 years to allow personnel time to find and report on weakness in material or design.

Procurement problems are often found and corrected during this period. After this "debugging" period, appropriate revisions are made and a USDA-Forest Service Specification is written. The Division of Fire Control is presently maintaining 85 active specifications for fire equipment and supplies. There are 38 specifications currently in various stages of development at the Forest Service Equipment Development and Testing Centers. The Centers also amend and rewrite specifications to incorporate different materials or performance requirements. It is estimated that over 200 Forest Service specifications are needed for all fire control items.

## *Qualified Products Lists*

Qualification tests are used to determine the acceptability of some fire equipment. After these tests a list is compiled of the products that will meet

rigid field performance requirements, for example, the engine-driven pumpers used in fire control which are tested according to Forest Service Specification 5100-273a. Exhaustive tests are made of various pumper models and types, and those that qualify are listed as acceptable for their designated purpose. Manufacturers submit their models to the Arcadia Equipment Development and Testing Center for qualification and often witness the testing operation. This service enables manufacturers to eliminate weaknesses in their equipment to qualify for Government bidding.

### *Forest Service Standards*

Forest Service standards are used as detailed descriptions of materials, processes, methods, designs, drafting room and other engineering practices. The standard is written to achieve the highest practical degree of uniformity of materials or products, primarily for ease of handling and interchangeability of components.

Standards are used in specifications, invitations for bids, proposals, and in contracts. A good example is Forest Service Interim Standard 5100-0070, which is a checklist of components for a complete kitchen and mess outfit. The standard includes instructions for assembly, with pictures and illustrations of special containers in the outfit.

In addition to providing guidance for procurement officers, there are many benefits from the Forest Service specifications and standardization program, such as:

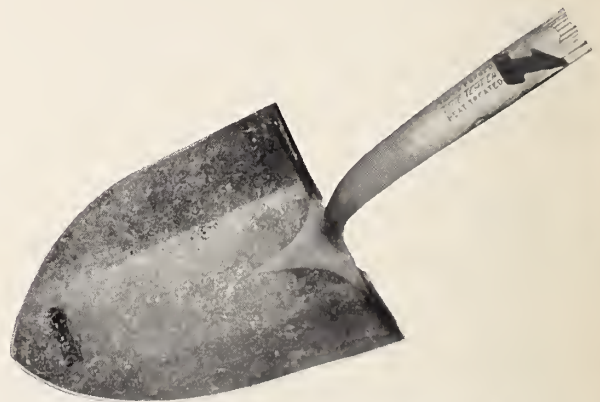
1. Reduction in variety of sizes, types, and grades of items needed in fire control operations.
2. Procurement of greatest practical uniformity of dimensions to promote interchangeability and replacement of parts.
3. Uniformity in production, inspection, testing and processing which also helps in training personnel to use fire equipment.
4. Adoption of uniform terminology and definition of technical, engineering, and supply practices.

5. Utilization of work done by industry, technical societies, and other agencies to avoid duplication of testing and research.

6. Aids in selection of commercial products that meet our acknowledged performance requirements.

7. Standardization of purchasing. Specifications may be used by General Services Administration as purchased descriptions for procurement.

The development of the firefighting shovel, size 1, is a fine example of the progression from the employee improvement suggestion to the development project assignment to Arcadia Equipment Development and Testing Center which finally resulted in manufacture of the shovel under the new Forest Service Specification 5100-00326. Manufacturers and Forest Service field personnel made their comments throughout the specification development. General Services Administration has been instructed to purchase pilot quantities, and the next step will be to include firefighting shovel, size 1 in the GSA Forest Firefighting Equipment and Supply Catalog.



Firefighting shovel size 1, Forest Service Specification 5100-00326

In the final analysis firefighters, crew bosses, and Rangers will decide whether this shovel meets their needs. Specifications and standards are obtainable upon request to the Chief, Forest Service, U. S. Department of Agriculture, Washington, D. C. 20250.

**FIRE POWER.**—Conservation Department records show that the diesel locomotive was the leading cause of Wisconsin forest fires in 1962.

## FIRE HAZARD ON TOBAGO

MERRILL E. TESTER, *Forester,*

*Division of Fire Control, Missoula, Mont.*

Mr. Tester, Fire Control Specialist from Missoula, Mont. went to Tobago in October 1963 to assist the Trinidad-Tobago Government with the fire hazard created by Hurricane Flora. This article reports on the problem and remedial plan developed.

Throughout the United States, fire hazard in timber areas is a common situation. Hazard is always present but the degree may vary. Few foresters realize that fire hazard can also exist on the tropical islands of the West Indies. This article deals with the fire hazard created on Robinson Crusoe's island of Tobago by Hurricane Flora.

Tobago is a small island of some 114 square miles and is 26 miles long by 7½ miles wide. It is located about 26 miles north of Trinidad and is part of the Trinidad-Tobago nation. The island was discovered by Columbus in 1498, with the first European settlement taking place in 1632. From 1814 to 1962 it remained under British rule. In August 1962, Trinidad and Tobago became an independent nation and a member of the Commonwealth.

The island of Tobago is situated roughly on a NE-SW axis with a main range of mountains running lengthwise along its middle. Most of its terrain consists of steep hills and sharp draws with elevations ranging up to 1,890 feet above sea level. Topography is generally young with highly erosive soils. Typical of many of the islands in the West Indies, Tobago is favored with a very pleasant climate. Prevailing wind is the NE trade, which blows with considerable constancy and force. Winds probably exceed 6 m.p.h.

at any time, being higher in the dry season. Mean annual temperature is 78°, varying between 65° and 90°. Relative humidity seldom is below 60 percent. Annual precipitation varies from about 56 inches along the coast to about 150 inches in the higher country. There are distinct wet and dry seasons, with March and April being the driest part of the year.

Situated astride the main ridge running lengthwise of Tobago is a 9,770-acre forest reserve. This reserve is one of the oldest in the Western Hemisphere, having been established by the English in 1765. The reserve is about 10 miles long and 1½ miles wide. Until 1958 no roads penetrated the reserve. Since then an access road has been partially completed across its middle, but most of the reserve is still inaccessible.

Hurricane Flora struck her first devastating blow on Tobago on Sept. 30, 1963, with no warning (fig. 1). In fact two blows were struck, with the first coming about 12:45 p.m. for 30 minutes, and the second and heavier blow about 2:00 p.m. for about 2 hours. Winds reached a high of 140 m.p.h. When Flora departed, curving upward to continue her havoc in Haiti and Cuba, she had turned Crusoe's smiling, unspoiled isle into a whimpering shambles. Twenty-four lives were lost, some 20 villages were wiped out, and more than 50 percent of the is-

land's 38,000 population was rendered homeless. Agriculture was almost no more. The extent of the damage was estimated at \$150 million.

Prior to the hurricane, the entire reserve was covered with a dense, primeval rain forest with very few trees of merchantable value. Slopes are steep with many ridges and draws. Elevation of the reserve ranges from 800 to 1,890 feet. Very little management of the forest has taken place, with only about 200 trees having been removed for commercial purposes during the past 10 years. The primary value of the reserve is watershed protection.

Damage to the reserve was heavy. Approximately 75 percent of the stems were blown over or broken off (fig. 2). The remaining stems had almost all of their crowns removed. Many of the standing stems were damaged so severely they will not survive. The resultant accumulation on or near the ground of trunks, limbs, and leaves caused a vast change in the fire hazard.

Prior to the hurricane the reserve had never known a fire problem. The entire area was well shaded with a solid canopy. Ground temperatures were low, surface moistures high, and flash fuels nonexistent. In a matter of hours, Hurricane Flora completely reversed this picture. The canopy was completely destroyed,

thereby creating the potential for higher ground temperatures, lower surface moisture, and a vast amount of flashy fuels. In effect, the Trinidad-Tobago government was confronted with a brand new fire problem of rather serious proportions. Coupled with this was the lack of experienced firefighting personnel and suppression equipment.

Fortunately, the fire hazard is of a short, transitory nature. High humidities, coupled with heavy precipitation, will tend to reduce the hazard quite rapidly through decomposition. It will further be alleviated by the rapid growth of new vegetation. It was agreed locally that the greatest risk would occur during the dry season of March and April 1964. After that, it should not be great enough to cause any serious problems.

The primary concern of the Trinidad-Tobago government was how to cope with this fire problem. Arriving at a solution was complicated by lack of access, erosive soils, lack of trained and experienced personnel, lack of suppression tools and equipment, short amount of time before the next dry season, and the transitory nature of the fire hazard.

Through the assistance of the Agency for International Development, I was assigned to help develop a plan of action. The final plan was prepared in late October and early November 1963. At the same time, members of the forestry and fire departments were given fire suppression training which covered organization, line construction methods, snagging, line location, burning out, and use of tools, dirt, and water. Basic recommendations of the plan were:



Figure 1.—View of forest reserve on Tobago after Hurricane Flora struck. (Photo courtesy Trinidad-Tobago Government.)



Figure 2.—Detail view of the reserve, showing many broken trees and heavy ground debris. (Photo courtesy Trinidad-Tobago Government.)

### *Prevention*

1. Develop and implement a strong, effective fire prevention program.
2. Restrict public entry on government lands during the dry season and smoking by work crews.

3. Require burning permits for all open fires during the dry season.

4. Strengthen government organization on Tobago to facilitate accomplishment of the prevention program.

*Continued on page 16*

## X FIRE HAZARD MANAGEMENT X

JOHN MORRISON, *Forester,*  
*Bitterroot National Forest*

About 100 years before Lewis and Clark passed through western Montana in 1805, a large fire or a series of large fires burned about 1 million acres that later became portions of the Bitterroot, Deerlodge, and Beaverhead National Forests. In this burn a lodgepole pine stand became established and eventually flourished. The stand became over-mature and in the late 1920's was struck by a bark beetle epidemic which killed between 65 and 90 percent of the stems. Most of the snags have fallen down in subsequent years (fig. 1).

When the snags were standing and the first few years when they were on the ground, the fire hazard was not greatly increased. However, in recent years decomposition has greatly increased their combus-

tibility. A tangle of reproduction, mostly alpine fir, became established under the opened stands (fig. 2). This was the setting for the Sleeping Child Fire which started from a dry lightning storm on Aug. 4, 1961. In spite of rapid initial attack, this fire enveloped 145 acres in 2 hours and spread to 9,000 acres in 24 hours (fig. 3). The fire continued to spread until August 13, when it was controlled at 28,000 acres.

Fires such as the Sleeping Child Fire are very costly to control. However, a conflagration-type fire such as this must be controlled as quickly as possible because of its destructive potential to forest resources and improvements. Such a conflagration in these fuels could spread with force to hundreds

Figure 1.—Lodgepole pine high hazard area showing the heavy ground fuel accumulation.





Figure 2.—High hazard area. Trees killed by bark beetle infestation in the late 1920's are mostly on the ground.



Figure 3.—Sleeping Child Fire, Aug. 9, 1961.

of thousands of acres and destroy all that is on them. Reduction or elimination of these fuels, at the cost of controlling one conflagration, would reduce the hazard on an area many times the size of the conflagration. The Sleeping Child and Saddle Mountain Fires reemphasized this need.

There are still over 200,000 acres of these high-hazard fuels on the Bitterroot National Forest. This

area is producing little or no valuable timber, owing to dwarf mistletoe in the lodgepole pine understory and the poor potential and low quality of the alpine fir. It has not been developed because of its present low value, and roads generally stop on its perimeter.

In the fall of 1962, the Bitterroot National Forest started development of a hazard management plan for these areas. Objectives of the plan are to (1) minimize the possibility of conflagration-type fires; (2) salvage all available merchantable material; (3) reduce the fire hazard; (4) bring timber production to or near full potential.

Before field work was started on the plan, work maps were made for the general high-hazard area. Two-inch-to-the-mile timber management plats were used. The lodgepole pine pole and sawtimber types were shaded on the plats so that they could be readily checked in the field. Ridges were also shown. Two observers field-checked the area by helicopter. The heavy fuel types were readily discernible. The aerial base timber plats were invaluable in delineating the high-hazard areas which, as well as possible helicopter spots and natural firebreaks, were recorded on the maps.

After the field check, boundaries of the high-hazard areas were outlined on a ½-inch forest map. They were then subdivided into 16 units where drainages or natural firebreaks were used as unit boundaries. These units vary in size from 5,000 to 26,000 acres. Two-inch-to-the-mile base maps were prepared for each unit showing hazard and major timber types. An improvement overlay was made for each unit showing (1) planned roads, (2) planned helispots, and (3) planned firebreaks. A written section was made for each unit which shows (1) estimated volume of commercial timber by species and (2) estimated cost of proposed roads, helispots, and firebreak construction.

The units were further broken into blocks which are being used as work units and for which intensive on-the-ground plans will be made.

In implementing the plan, first consideration is given to a transportation system of roads and helispots needed to provide better protection until fuel reduction can be accomplished. Helispots in the very heavy fuel areas are given highest priority. These will be used by helitack to speed up initial action on fires. Roads are also assigned construction

priorities. Second consideration is given to harvesting merchantable timber, and third to reduction of the fire hazard and establishment of a new timber stand. Establishment of a new timber stand will, in most cases, be accomplished by leaving seed trees on the areas which are prepared for prescribed burning.

A start was made in 1963 toward implementing the plan. Fifteen helispots were constructed, and a construction contract was let for 5 miles of the highest priority road. In addition three areas totaling 160 acres, where merchantable timber had been salvaged, were prepared for prescribed burning. In preparing the areas, from 10 to 20 lodgepole pine seed trees per acre were left to help establish a new timber stand. The remaining trees and snags were felled to provide flash fuels to carry the fire and ignite the heavier fuels. The seed trees will be killed by the fire, but their cones will open and reseed the areas to lodgepole pine.

Preparation of the areas was accomplished by the interregional fire suppression crew stationed on the Bitterroot Forest at Trapper Creek. The flash fuels had not dried sufficiently to ignite and carry fire in the fall of 1963. Plans are to burn the areas in the fall of 1964 (fig. 4).



Figure 4.—Area prepared for burning. The seed trees will be killed when the area is burned.

The areas to be burned were selected for their potential to serve as firebreaks or barriers to keep wildfires from becoming conflagrations. Eventually the hazard on the entire area should be reduced to a level that will not be conducive to large fires. This will be done in conjunction with intensive resource management.

#### **Airdropped Slurries—Continued from page 4**

crowns did not materially impede the slurry passage to the ground. The length of the ground pattern exceeding one-half gallon per 100 square feet through the bare hardwood crown was about equal to that for an open area. Application rate zones exceeding 2 gallons per 100 square feet were lacking in these hardwood drops, but were present in both the open and pine drops. Thus, while the open and hardwood patterns were comparable in size, less slurry actually reached the ground through the bare hardwood canopy.

Nevertheless, a 220-gallon drop should effectively retard the advance of a low-intensity fire in the understory. If a hardwood stand is in full leaf, however, not even a 440-gallon drop will penetrate the crown canopy sufficiently for fire retardant action.

---

#### **Ground Attack—Continued from page 7**

4. Corrosive to most metals. A corrosion inhibitor which makes possible long-term storage in steel containers can be added by the manufacturer.

5. Mixture of Pyro and water begins to freeze at temperatures slightly less than 32°F.

6. Pyro will leak through joints and seams that were considered watertight.

7. Equipment used only periodically may tighten or freeze up from dried deposits of Pyro.

a. Complete flushing with water is good preventive maintenance.

b. Small, premeasured containers of pure Pyro can be carried in vehicles for use in backpack tanks.

8. Pyro's retardant effect appears to remain on vegetation until leached or weathered away.

9. Use of various ratios, including pure Pyro, in a powered, backpack mist blower proved unsuccessful.

10. Penetration appears to exceed any retardant we have used to date.

### Water Tanks—Continued from page 8

minutes using the low-volume nozzle. By changing to the higher volume garden nozzle the effectiveness of the stream is increased somewhat, but the spray time is cut to approximately 15 minutes. We have found that the increased spray time usually outweighs the advantage of a greater volume of water.

By using a surplus or discarded pressure tank, the cost of the unit should not exceed \$20 including the hose and nozzle.

The air pressure powered water tanks used through one fire season have already proved their worth. In many instances one man was able to stop a hot, fast-moving fire, thus saving the expense and time involved in dispatching a fire plow unit.

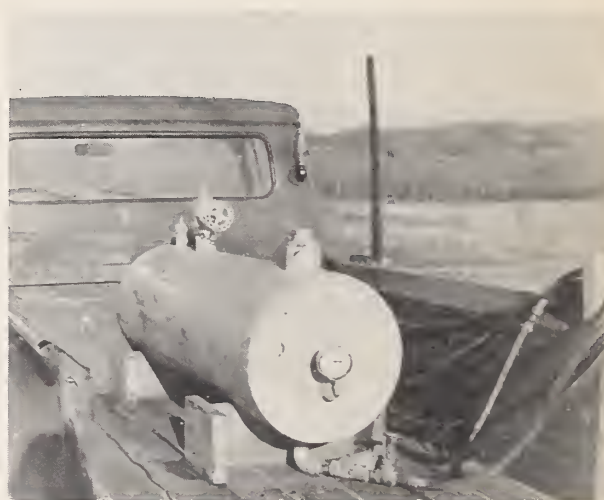


Figure 2.—Sixty-gallon air pressure water tank mounted in rear of truck.

### Tobago—Continued from page 12

#### Presuppression

1. Supplement firefighting equipment with tools designed to fight fires in heavy fuels.

2. Organize and train selected groups of cooperative smokechasers.

3. Establish tool caches at locations of cooperating smokechasers.

4. Use a small fixed-wing aircraft for supplemental detection.

5. Organize and train cooperative detectors.

6. Develop a map of all transportation routes, both road and trail.

#### Suppression

1. Develop and implement a fire training program for government employees and selected co-operators.

2. Specialized equipment such as helicopters, large aircraft, radios, and retardant are not needed.

3. Additional mobile firetrucks are not needed.

4. No attempt should be made to construct firebreaks throughout the reserve.

5. No attempt should be made to construct more access roads in the forest reserve before the next dry season.

66 Fi

# FIRE CONTROL NOTES

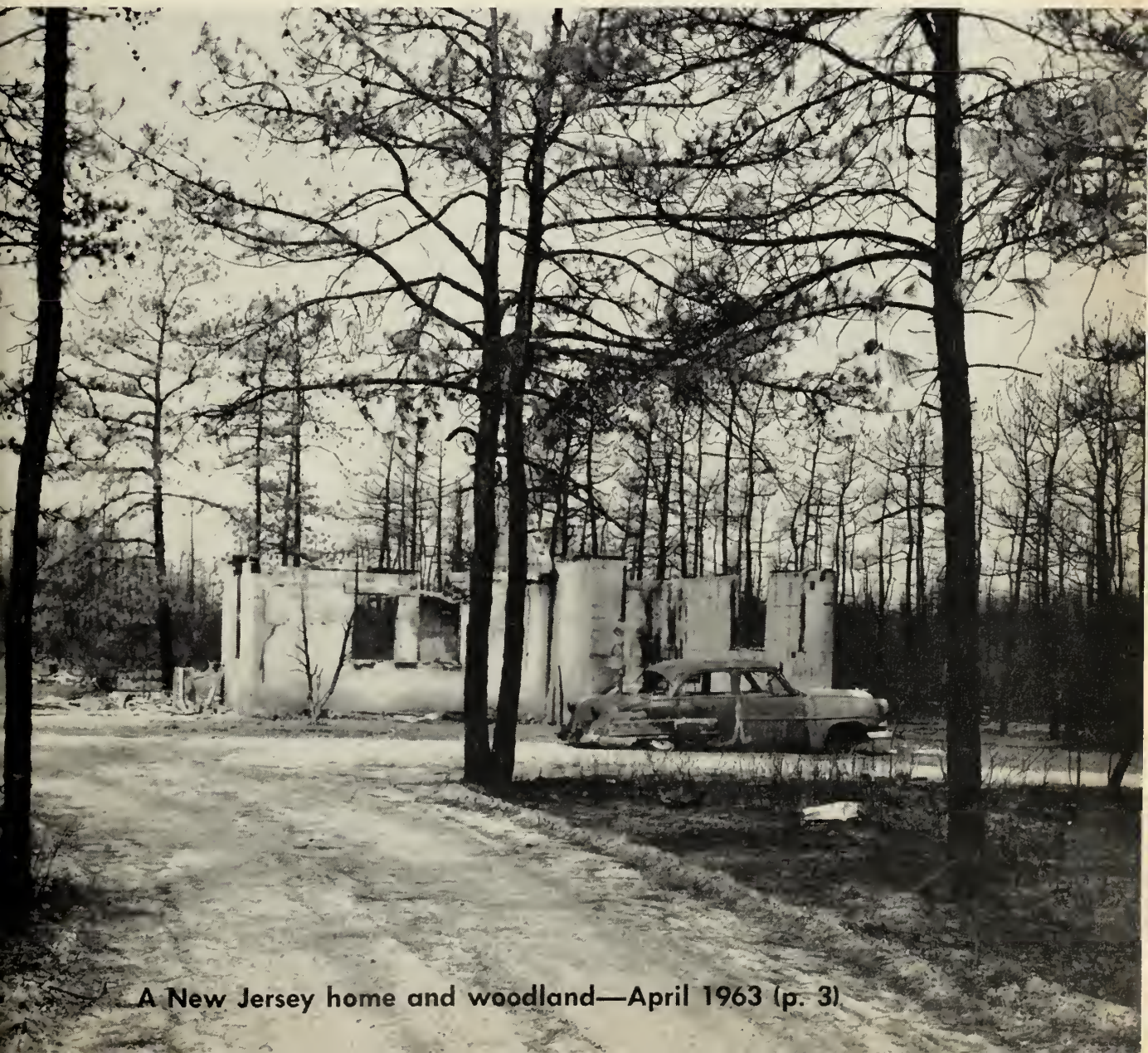


U. S. DEPT. OF AGRICULTURE  
NATIONAL AGRICULTURAL LIBRARY

AUG 4 - 1964

CURRENT SERIAL RECORDS

U.S. Department of Agriculture  
Forest Service



A New Jersey home and woodland—April 1963 (p. 3)

# FIRE CONTROL NOTES



*A quarterly periodical devoted to forest fire control*

## CONTENTS

<i>Page</i>	<i>Page</i>
3 The forest fires of April 1963 in New Jersey point the way to better protection and management WAYNE G. BANKS and SILAS LITTLE	12 An unusual potential cause of forest fires G. S. CHESTER and E. J. HOPKINS
7 Forest fires and fire weather conditions in the Asheville, N.C., fire weather district—spring season, 1963 EARNEST A. RODNEY	13 Deer hunters are careful with fire when properly approached DAVID D. DEVET
10 The emergency backpack kit GERALD F. EWART	14 New spark arrester legislation in California
11 A portable fire-weather forecast unit for use on back-country fires HOWARD E. GRAHAM	14 Retardant hose skate GEORGE CARBERRY
	15 Modification of 3-way valve on retardant pumps HORACE G. COOPER
	16 Propane gas installation for lookout tower HOWARD BURNETT

## INFORMATION FOR CONTRIBUTORS

Please submit contributions through appropriate channels to Director, Division of Fire Control, Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250. Articles should be typed in duplicate, double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and organization.

Authors are encouraged to include illustrations with their copy. Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints or India ink line drawings are acceptable. Captions for illustrations should be typed in the manu-

script immediately following the paragraph in which the illustration is first mentioned, the caption being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the caption to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

FIRE CONTROL NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D.C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. Use of funds for printing this publication approved by the Director

of the Bureau of the Budget (Sept. 16, 1963).

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, 20 cents a copy, or by subscription at the rate of 75 cents per year, domestic, or \$1.00, foreign. Postage stamps will not be accepted in payment.

# THE FOREST FIRES OF APRIL 1963 IN NEW JERSEY POINT THE WAY TO BETTER PROTECTION AND MANAGEMENT

WAYNE G. BANKS and SILAS LITTLE, *Research Foresters,  
Northeastern Forest Experiment Station*

In the spring of 1963, conditions conducive to severe forest fires prevailed rather generally throughout the Northeastern States. Scant rainfall, low humidity, and high winds combined to produce high and extreme fire-danger ratings for prolonged periods. On April 20 fire danger reached a peak in several areas. As a result, fast-moving fires of unusual intensity burned out of control.

The New England States were fortunate in escaping really large fires; the largest was approximately 700 acres in northern Maine. However, New England did have many small fires. Massachusetts, for example, had 4,861 forest fires in April, a record for that State and possibly for any State.

Fire disasters made the headlines of many newspapers. In New Jersey, newspapers reported more than 200,000 acres burned and 458 buildings destroyed (fig. 1). These reports listed 7 persons dead, many injured, and 2,500 evacuated—of whom 1,000 were left homeless. New York newspapers reported that a brush fire on Staten Island covered 10 square miles and destroyed 100 homes. In the suburbs of Philadelphia, and elsewhere in Pennsylvania, homes were threatened by numerous woods fires. Fast-moving fires were reported in Maryland, West Virginia, Virginia, and Kentucky were also hard pressed to control their many fires.

Whether these newspaper statements were correct in all details is probably not very important. But what should be important to foresters and the general public are the reasons for these disasters, the ways of preventing them, and the probability of similar conditions occurring again. The second seems particularly important because on April 20, when most of the damage occurred in southern New Jersey, fire suppression techniques and pre-suppression measures proved woefully inadequate.

## *Weather Conditions*

April 1963 was the driest April on record in New Jersey. Only 0.31 inch of rain fell during the first 29 days of the month, and 0.52 inch on the 30th. On 22 days, maximum wind velocities at Trenton were 20–40 m.p.h. In the 30 days prior to April 20, precipitation deficiency amounted to 3 inches. Relative humidity on that day dropped from 50 percent at 6 a.m. to 23 percent at 10 a.m. and remained be-

tween 20 and 23 percent until nearly 5 p.m. Temperature was 80° F. at midday, dropping to 53° at midnight. Fuel moisture indicator sticks at two fire-danger stations showed 3.5 and 4.1 percent fuel moisture at 2 p.m. At both stations the buildup index was 100 and the burning index was 200 on the 8-0 meter.

The estimated average wind velocity for April 20 was 20 m.p.h. The average of the maximum wind velocities reported from the three nearest Weather Bureau offices was 33 m.p.h., and gusts were probably as high as 50 m.p.h. Turbulence prevailed at low levels, and many small whirlwinds developed. Prevailing wind direction veered during the day from northwest to west, then back to northwest, and to almost north late at night.

## *Comparable Conditions in the Past*

Because April was such a black day for fire protection in New Jersey and in sections of neighboring states, we attempted to determine the past frequency of such weather conditions. Weather Bureau records for the previous 49 years indicated that the spring fire weather was never quite so bad as in 1963. During that half century only four spring days had conditions that approached those of April 20, 1963. In early May 1930, when fires were rampant in South Jersey, surface burning conditions on two days approached those of April 20. The chief difference was that, in the 30 days preceding April 20, 1963, there had been an inch less precipitation than in the 30 days preceding May 2 and 4, 1930.

However, previous seasons have had conditions comparable to April 20 in both wind velocity and drought. Since 1913 there have been six fall days of apparently similar conditions, and one summer day and four fall days when conditions approached those of April 20. However, because of less wind within stands in summer and early fall, the shorter days of fall, and less fresh leaf litter, we doubt that any of these days actually provided burning conditions as critical as on April 20, 1963.

On several other days of that April there were high winds. Fuel moisture was low, and at one danger station the buildup index registered 100 on 10 days. But at no time did all the elements of

fire danger combine to create conditions so severe as those on April 20, although April 29 was fairly close.

### *Fire Behavior*

Because of the drought, low humidity, and high winds, some of the fires of April 1963 started and spread in fuels so light that normally they are considered insufficient to maintain a fire. Owing to intensity, rapid spread, and ability to carry across very light fuels, suburban fires were difficult to suppress, and many buildings were lost.

In the heavier and more flammable fuels of the New Jersey Pine Region, the wind-driven fires burned with great intensity and caused severe damage to both oaks and hard pines. Fires spread rapidly across upland sites where there was relatively little fuel, as on areas where prescribed burning had been done 1 or 2 years earlier. On such sites a very light cover of pine needles was sufficient to maintain a fire. Oak leaves, where present, were blown across bare spots so that fires advanced rapidly even in scattered fuels.

Because fuels contained so little moisture and winds were so strong, the rate of spread of fires on April 20 was extreme almost regardless of fuel type. One of the larger fires, which started just north of the Lebanon State Forest, advanced about 3½ miles in 2 hours and 9 miles in 6 hours. Probably the rate of spread on April 20, 1963, has been matched or even exceeded by other fires for short periods. However, foresters and wardens with many years' experience in fighting South Jersey fires could recall no case where the sustained rate was as high as on April 20. The Forest Fire Service of the New Jersey Department of Conservation and Economic Development provided data from 1924-63 that showed only 1930 to be comparable to April 1963 in number of large fires and their rate of spread. The two fires with the greatest area burned per hour were in 1963 and covered about twice as much ground per hour as any of the much-publicized 1930 fires for which complete data are available. The data also emphasize the importance of April and May in local protection problems.

### *Suppression Difficulties*

The New Jersey Forest Fire Service uses a combination of suppression techniques and several kinds of machines. The latter include trucks of various sizes up to 500-gallon tank trucks equipped with 4-wheel drive; aircraft equipped to drop 150-200 gallons of retardant; and tractor and plow

units. Backfiring and handtools are also used, and backfiring plays a large part in stopping head fires and tying in flank fires.

On April 20 none of the suppression methods proved effective. For example, only one of the three pilots employed for firefighting was willing to fly, considering the 40-m.p.h. winds and the low-level turbulence. Effectiveness of tractor and plow units on April 20 was confined to areas with no more than 1 year's accumulation of litter, and that mostly pine needles. Tank trucks and handtools were useful in controlling spot fires in 1-year needle litter, but in oak leaf litter neither was enough. For example, at about 1:45 p.m. between New Lisbon and Route 70, a spot fire started along a road within 50 feet of a tank truck, its crew, and several men with handtools. At that particular moment, a small whirlwind spread this fire for 100-200 feet. High winds forced the abandonment of suppression attempts, even though the area had only a year's litter since the last prescribed burn.

The extremely dry and windy conditions caused much difficulty in backfiring. Attempts to backfire and hold the line along sand, gravel, and even blacktop roads had to be done slowly and carefully to prevent the backfires from jumping the road. Backfires along a State highway crossed the road even though the cleared strip in that area ranged from 75 to 120 feet wide. In some places head fires arrived before backfiring could be completed.

### *Effectiveness of Prescribed Burns*

Prescribed burning in the winter to facilitate suppression of fires in the South Jersey Pine Region has long been advocated. However, this measure too proved less effective on April 20, 1963, than in previous wildfires.

In general, prescribed burning 1 or more years before the wildfires of April 20 did not facilitate suppression appreciably, especially where oak litter was an important component of the fuel complex. In these areas the 1963 fires were not stopped under fuel conditions that had permitted the suppression of earlier wildfires.

More recent burns that left some surface fuel remaining only reduced the damage, and others that removed nearly all the fuel did not stop the fire. On one firebreak where the 1962-63 winter burn had consumed only the top litter, the fire burned with sufficient intensity to kill many of the oaks and severely scorch the crowns of the pines (fig. 1).



Figure 1.—The stands on both sides of this road had been prescribe-burned in the winter of 1962–63. A good burn had been obtained on the left side, and here the fire of April 20, 1963, burned only a few scattered patches. On the right side, only the top litter had been burned by the winter fire, and much damage was done in April.

Rapid combustion of wind-tossed dry fuels in the April 20 fires created extreme temperatures and greater damage on prescribed burn areas than in other years. On areas with 1 year's accumulation of litter after periodic burns, head fires killed most of the oaks but not the overstory pines. Strong flank fires on such areas killed about half of the overstory oaks. Damage to oaks in areas with 2 or more years' accumulation of litter was usually about as severe as in stands with no previous prescribed burning. However, any reduction of fuel was apparently effective in reducing damage to pines.

#### *Preventing Similar Disasters*

*Prevention.*—One of the major fires of April 20–21

reportedly started where a debris burner had a permit for night burning. The fire held over in a brush pile and broke out on April 20. At the nearest fire-danger station the buildup index had reached 59 on April 12, climbed steadily to 100 on the 17th, dropped to 97 on the 18th, but was back at 100 on April 19th.

We suggest that no burning permits, for either day or night, be issued when the buildup index is 60 or more according to the system now in use in the Northeast. Any permits issued when the buildup index is less than 60 should be so limited in time that they will expire before the index reaches 60.

Camping should be prohibited at remote sites when the buildup index reaches 60, and at all areas when the index is 80 or more. Prohibiting camping may meet resistance; yet such a measure is needed as much for the safety of the campers as for fire prevention. On April 20, 1963, a large group of Boy Scouts were camped in the Lebanon State Forest, where only a slight shift in wind direction would have brought a head fire, quite possibly before they could have been evacuated.

Another important prevention activity is reduction of fuel through prescribed burning during the winter in types where these burns are silviculturally desirable. Earlier recommendations for the South Jersey Pine Region appear to remain sound:

1. For maximum protection of improved property, burns at 1- or 2-year intervals be used.
2. For extensive forested properties, barrier zones be prepared by the prescribed burning of belts of upland sites, which would reinforce swamps or other natural firebreaks.
3. Eventual development of a checkerboard pattern on upland sites in the larger unimproved holdings, i.e., a pattern of young unburned stands and of older, periodically burned stands. Prescribed burns at 4- or 5-year intervals are considered essential in a protection program.

In years like 1963, only recently burned areas will be effective barriers against fire. But in view of the rarity of such extreme fire danger, an annual and more costly fuel reduction seems justified only near buildings or other improved property.

Management for pine over oak, besides favoring the production of timber, can facilitate fire control under certain conditions. Periodic prescribed burning in areas with few oaks results in less rapid combustion of the rather compact needle litter. In April 1963 the burning needles were not carried long distances by the wind as oak leaves were. Suppression was therefore easier in stands that had few oaks.

*Presuppression.*—What can be done in presuppression to help ensure initial-attack success under fire conditions such as had developed in April 1963? We suggest broadening the scope of the working agreements between the New Jersey Forest Fire Service and other State agencies, companies, and individuals to furnish equipment when it is needed. Needed equipment from outside sources should be

on standby whenever the fuel and weather conditions indicate a conflagration threat.

Protection agencies might also consider providing tanks of 500-gallon capacity or larger and equipped with their own pumping units. These tanks could be strategically located, and stored in such a way that they could be mounted on flat-bed or dump trucks and put into operation quickly.

The responsibilities of most forest fire protection agencies today extend to much more than protecting woodlands alone. The extension of residential building and industry into rural wooded areas, the reversion of farmland to forest, and the development of forest recreational areas are now making high-value improvements and even lives dependent on the efficiency of forest fire suppression. Public recognition of these increasing responsibilities must be encouraged if protection agencies are to receive the financial support that they need.

*Suppression.*—What can be done to control fires under conditions such as prevailed in New Jersey and other parts of the Coastal Plain in April 1963? When the high winds eliminated the small airplane as a working tool, suppression forces found themselves back to conventional weapons—tanker trucks, plows, and hand crews—which were inadequate. Perhaps larger aircraft, carrying heavier loads and effective under windier conditions, and larger tanker trucks with multiple pumping units might be feasible. Although the latter might not be adequate for such fires as occurred in April 1963, they should prove effective against many fires that cannot now be attacked directly. They could also be a valuable aid to backfiring.

Also the use and coordination of equipment could be improved. Much difficulty was experienced in holding backfires, even along wide cleared rights of way. Could tanker units of the type available, supported by large tank trucks for refilling them, adequately fireproof the fuels on the opposite side of the roadway to permit rapid and safe backfiring from such roadway? This type of operation might require planning and practice. It might very well resemble the "one-lick" method used by hand crews, with several tankers proceeding in tandem at a reasonably good speed, each one spraying a designated portion of the fuels. Studies to determine the feasibility of this approach should be initiated.

# FOREST FIRES AND FIRE WEATHER CONDITIONS IN THE ASHEVILLE, N.C., FIRE WEATHER DISTRICT—*Spring* SPRING SEASON, 1963

EARNEST A. RODNEY, *Meteorologist in Charge, Weather Bureau Office, Asheville*

The Asheville Fire Weather District comprises an area of some 257,000 square miles with 78,550,000 acres of forest land under national, State, and private protection. The acreage and fires occurring on the nine national parks in the District were not available for inclusion in this summary.

In the District there are 117 administrative units of Federal, State, and private forest lands. During the spring season from February 15 through May 15 fire weather forecasts are forwarded to approximately 100 of these units six days each week. Four-day outlooks are included on Mondays, Wednesdays, and Fridays. Owing to the critical forest fire conditions existing in 1963, some routine forecasts were continued into June. From March 30 through May 19, 1963, 91 special forecasts were issued for "going fires" for various units in the area. The spring fire-weather season of 1963 was probably that of the most devastation since spring of 1942. In the 4-year period 1959 through 1963, 968,073 acres of forest were destroyed by fire in the District, an average annual loss of about 242,018 acres or 0.3 percent of all forest land under protection. In the spring of 1963 (table 1) three times as much of the forests burned, compared with the annual average for the previous 4 years.

## Precipitation

Most of the District had below-normal rainfall in three of the four months from January through April. South Carolina is possibly the only area with near-normal precipitation for the 4-month period. Most of the heavy precipitation was over by March 15-20, setting the stage for the dry (fig. 1), warm weather of April. On April 6 and 7 there was some heavy rain in North and South Carolina, but in general there were no beneficial rains until the end of the month. This deficiency of rainfall had its effect in keeping the forest fuels dry during the later part of March and all of April.

## Temperature

Temperature over the entire District averaged from 4 to 10 degrees below normal in January and 6 to 8 degrees below normal for February. After the first few days in March, temperatures were above normal, and the month averaged 4 to 6 degrees warmer than normal. April also was about 4 to 6 degrees above normal and can be characterized as warm, dry, windy, and dusty.

TABLE 1.—*Summary of fires on protected forest areas, Asheville, N.C., Fire Weather District, by States, Jan. 1–June 30, 1963*

State	State and private				National Forests			
	Forest area	Number of fires	Average size	Area burned	Forest area	Number of fires	Average size	Area burned
	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>
Ky. ....	9,854,000	3,351	65.6	219,975	575,000	94	18.1	1,706
N.C. ....	17,279,000	3,449	76.3	263,000	1,485,000	151	33	4,987
S.C. ....	11,175,000	3,856	14.6	56,173	621,000	133	21.7	2,892
Tenn. ....	10,119,000	3,371	11.2	37,890	937,000	128	46.2	5,909
Va. ....	14,033,000	2,369	16.3	38,542	1,709,000	149	16.1	2,403
W. Va. ....	9,007,000	1,552	45.2	70,121	906,000	15	1.5	22
Ga. ....	.....	.....	.....	.....	850,000	53	14.8	786
Total .....	71,467,000	17,948	.....	685,701	7,083,000	723	.....	18,705

## Upper Air

Figure 2 shows the mean circulation existing in April 1963 and gives the average height, isotherms, and resultant winds at the 700-mb. surface. The flow is also representative of that which prevailed during the latter part of March. During this time mean troughs were located off both coasts of the United States and a ridge over the Central States. Thus the general flow over the Asheville district was from the west and west-northwest. Not only does this type flow restrict the northward and eastward transport of moisture, but also the anticyclonic nature of the circulation tended to inhibit precipitation.

When the flow of air was from the Gulf of Mexico, the frontal systems moved through so fast that the warm air did not attain sufficient moisture content for much precipitation before being forced off the east coast. Also, because of the general upper-air circulation, any of the lows developing to the west moved from the southwest to the northeast. This resulted in only the trailing cold fronts passing through the District. This type of front seldom has much precipitation associated with it as it passes through the southeastern states.

## Surface

On April 3 at 1:00 p.m., e.s.t., a front was oriented northeast-southwest in the vicinity of Chicago, Peoria, Little Rock, and southwest into Texas. Temperature readings in the District were in the 80's to low 90's with dewpoints 55 to 60 degrees. Winds were generally light southwesterly. During the following 24 hours the front moved 25 to 30 m.p.h. to the coastal areas of North and South Carolina. To give some idea as to how dry this frontal passage was, *Climatological Data* for the States of North Carolina, South Carolina, Virginia, and Georgia lists a total of 0.08 inch of rainfall.

At this time forest fires were burning in many states of the District, and foresters faced great difficulties in fighting the head and flank fires as the dry, cold frontal system moved through.

April 4, 1963, was one of the most critical fire-weather days during the spring season. In North Carolina this date is referred to as "Black Thursday." Then, over 127 fires burned throughout the State. At least 43 class E (over 300 acres) fires were reported, with one fire of over 30,000 acres and another of 23,000 acres. A total of 185,000 acres burned in North Carolina on April 4. Air-

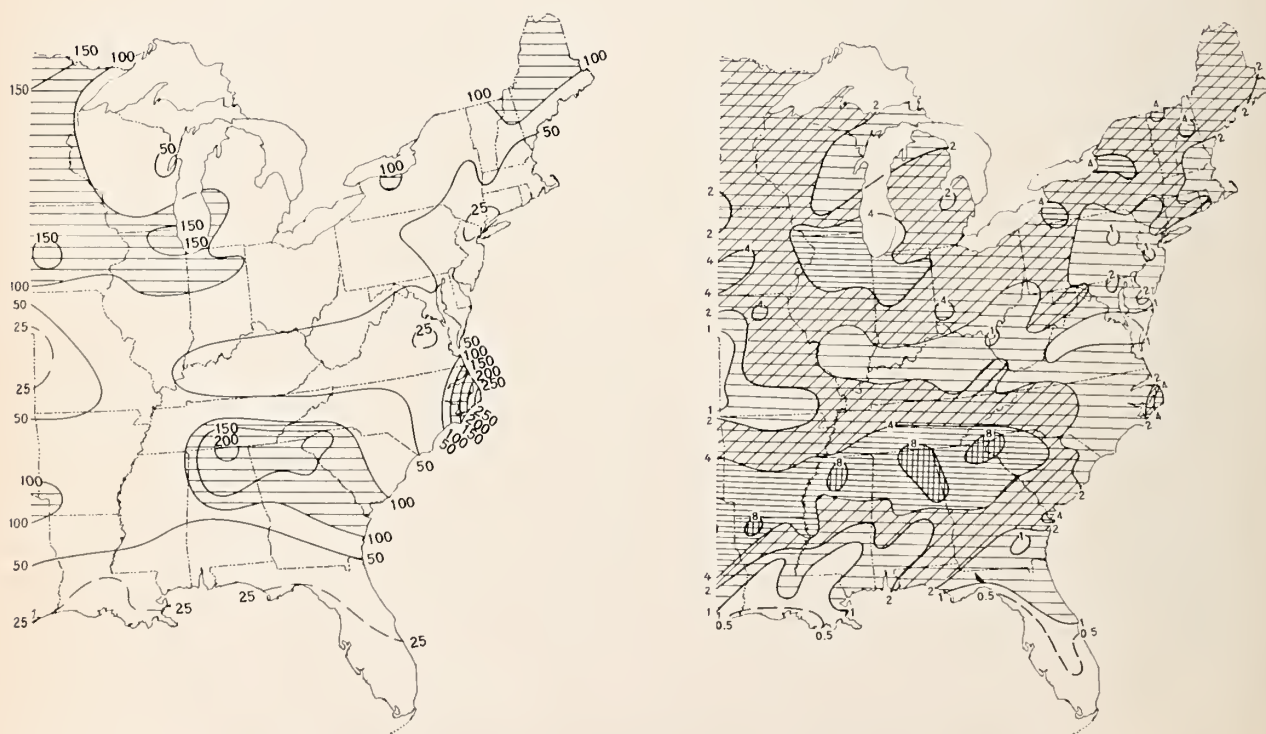


Figure 1.—Precipitation, April 1963: Left, Percent of normal; right, total (inches).

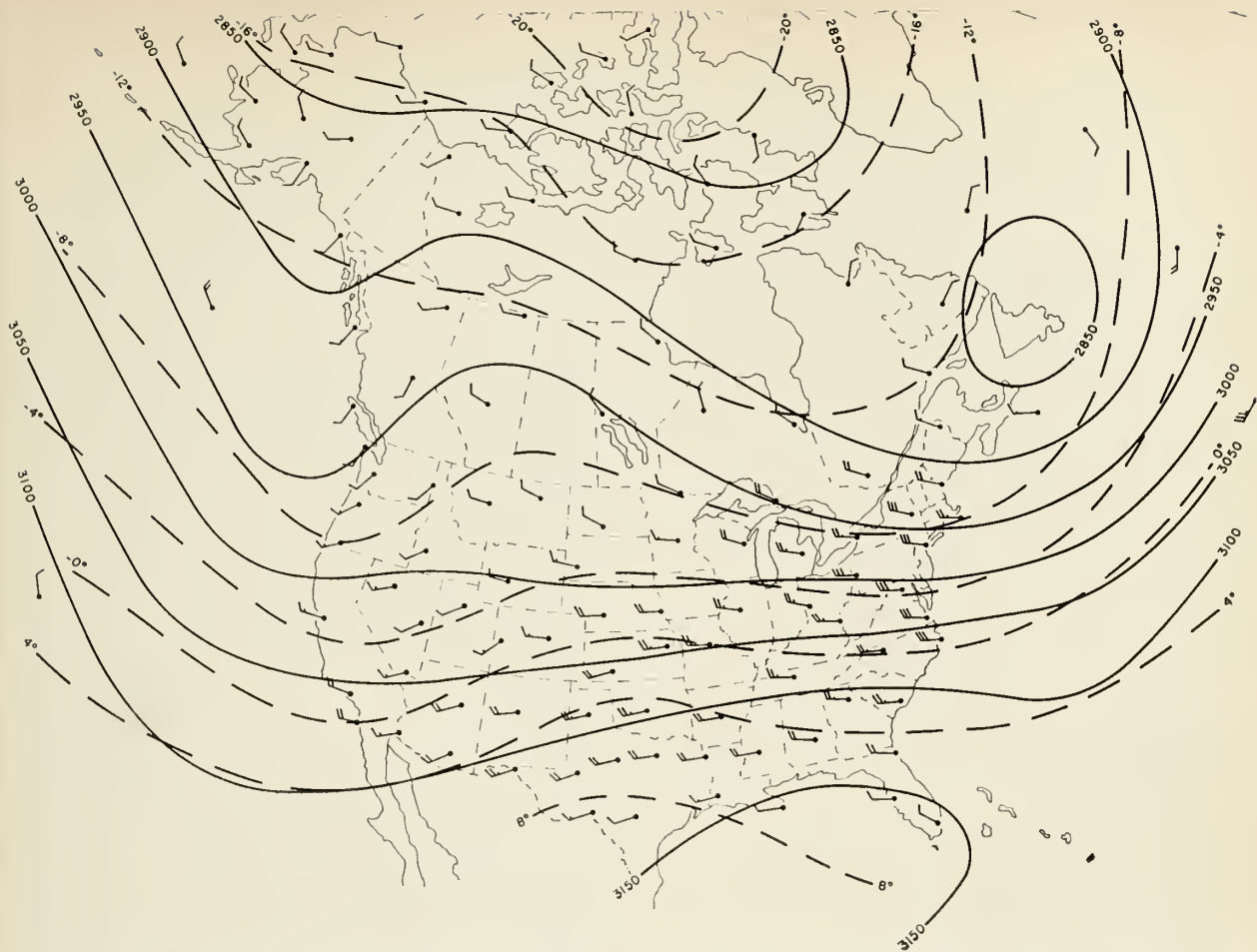


Figure 2.—700-mb. surface, 1200 G.m.t., April 1963: average height (geopotential meters) and temperature ( $^{\circ}$  C.), and resultant winds. (Windspeeds in knots; flag represents 50 knots, full feather 10 knots, and half feather 5 knots. Wind data based on rawin observations.)

craft, chemicals, and ground attack were used during this critical situation, but the control organization was hampered by the size and number of fires.

### *Fuel Moisture, Buildup Index, and Classes of Fire Days*

The fuel moisture is the moisture content of fine dead fuels, such as the surface layers of hardwood leaves or pine needles on the forest floor. The buildup index is a number on a 100-point scale that is directly related to the dryness of the layer of litter-type fuels (approximately 2 inches deep) that lies immediately beneath the surface layer. It is computed by cumulating daily factors according to the surface fuel moisture as reflected by the fuel moisture indicator sticks.

A day may be designated as one of five classes of fire danger. The fuel moisture, buildup index, windspeed, and condition of lesser vegetation are integrated by means of a fire-danger meter (South-

eastern Station Meter, Type 8) to give a Burning Index. The range of Burning Index is divided into five classes for planning and operational purposes. Class 1 indicates low fire danger, and class 5 indicates extreme fire danger. With the buildup index already high, combined with a dry cold front, wind, etc., all areas except northern West Virginia experienced a class 4 or class 5 fire danger day on April 4.

### *Summary*

1. The temperature was above normal in March and April.
2. Precipitation was below normal for the most part in all but March. After March 15 most of the precipitation fell on a few days through April.
3. The combination of lack of precipitation and above-normal temperature and sunshine caused the forest fuels to be very dry and brought about the most critical spring fire-weather season since 1942.

*Continued on page 15*

## THE EMERGENCY BACKPACK KIT

GERALD F. EWART, *Supervisory Fire Control Aid,*  
*San Bernardino National Forest*

The emergency backpack kit illustrated provides a radio for communication, first aid kit adequate for a 25-30-man crew in case of multiple injuries, and fuses to be used for emergency escape, burning out and firing. This pack was used extensively during the 1962 and 1963 fire seasons by the Del Rosa suppression crew and proved to be very practical. It provides for the crew's safety so many times overlooked because these items were not available when the crew began work. Previously the items were handcarried to the fireline, which resulted in their not being readily available when needed.

The contents of the pack are mounted on a canvas backpack board. A piece of nylon cord secures the radio, two small blocks of wood keep it level, and a short length of aluminum angle keeps it from sliding down. The first aid kit is mounted just below the radio with four small bolts. The fuses are mounted at the bottom of the pack-board with heavy elastic. A cover is need to protect the radio and first aid kit from dirt and

scratches. This can be made at any canvas shop for about \$10. Other crews should also find this pack useful and easy to make up.



Emergency backpack kit.

# A PORTABLE FIRE-WEATHER FORECAST UNIT FOR USE ON BACK-COUNTRY FIRES

HOWARD E. GRAHAM, *Meteorologist,*  
*Division of Fire Control, Pacific Northwest Region*

A portable fire-weather forecasting unit, developed by the Forest Service in cooperation with the Weather Bureau, will make local fire-weather forecasting available to firefighters in unroaded back country. This information has been unavailable because meteorologists were unable to take conventional mobile fire-weather forecast units into remote areas. The new unit contains all items needed for forecasting by the meteorologist at the fire and can be taken wherever horses can walk or helicopters can land.

The portable fire-weather forecast unit is compatible with Weather Bureau mobile units and other Weather Bureau communication equipment, and contains all items needed by the fire-weather

er forecaster for receiving weather data and compiling a forecast. Not included are topographic maps of the fire area and personal needs. Included are (fig. 1)

1. Radio for receiving current weather conditions from observers around the fire, and long-distance radio for receiving worldwide weather data from a special Weather Bureau transmitter.

2. Tent, worktable, chairs, and weather plotting charts.

3. Instruments for sampling weather conditions near the fire.

4. Small items such as paper, pencils, erasers, envelopes, and antennas for long-distance radio.

The equipment is packed for shipment in five wooden boxes (fig. 2). Total weight is 720 lb. Upon arrival at the fire camp, the

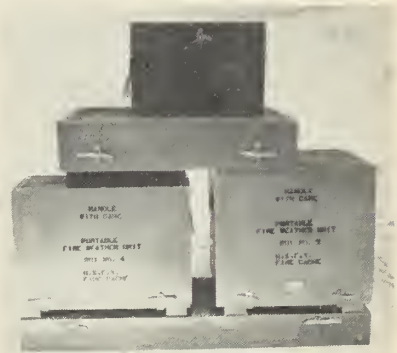


Figure 2.—Portable fire-weather forecast unit ready for dispatch when needed.

equipment must be unpacked and assembled before the meteorologist can begin forecasting.

Once assembled, operation will be similar to regular Weather Bureau mobile units. By agreement, Weather Bureau fire-weather meteorologists will operate the portable forecast unit whenever they are available. Therefore, although the unit will be ordered by the fire control agency, the decision for its use should be made jointly by fire control officials and Weather Bureau meteorologists. One, possibly two, meteorologists will operate the equipment. They will need to be assisted by one or two weather observers provided by the fire boss.

The portable fire-weather forecast unit is available for use anywhere in the country. It is stored in the Region 6 Fire Cache at Portland, Oreg. Dispatching will be handled like any other firefighting equipment. If the unit is needed, the Regional Dispatcher should be contacted to arrange transportation and other details.



Figure 1.—Components of portable fire-weather forecast unit

## AN UNUSUAL POTENTIAL CAUSE OF FOREST FIRES

G. S. CHESTER, *Research Officer*, and E. J. HOPKINS, *Technician*,  
*Forest Research Branch, Ontario District Office, Canada*

Stories of forest fires caused by focusing the sun's rays on a suitable fuel by pieces of broken glass or water in bottles are usually discredited as highly improbable or merely imaginative. Occasionally, though, one finds firsthand an ignition source that adds credence to the stories.

In April 1963, as part of a silvicultural project, small greenhouses ( $6.5 \times 6.5 \times 5$  feet, sloping to 4 feet at rear) were erected in an aspen stand located in Essa Township near the town of Barrie. The greenhouses, of light frame construction, were covered with polyethylene sheeting.

On June 17, Department of Forestry personnel detected the smell of something burning and, on investigating, found a strip of charred and smoldering duff ap-

proximately 12 inches long in one of the greenhouses (fig. 1). Close examination revealed that rain-water had collected on the roof of the shelter, and the resultant pool was acting as a burning lens. The pool was dumped and the smoldering material extinguished.

At the time of discovery the pool was approximately  $2\frac{1}{2}$  inches deep and contained an estimated  $1\frac{1}{2}$ –2 gallons of water (fig. 2). No information is available on how long it had been there. The shelter was in full sunlight from about 7:30 a.m. (e.s.t.) on the morning of June 17. The smoldering duff was discovered at 2:35 p.m. and according to calculation had been smoldering for approximately 50 minutes.

Conditions inside the greenhouse at the time of the incident were as follows:

*Drought.*—The duff layer was extremely dry, having received no moisture since the greenhouses were erected in April.

*Air temperature.*—The maximum air temperature on the day of the incident was  $102^{\circ}$  F. inside the shelter and  $86^{\circ}$  F. outside. Inside and outside minimum temperatures the night before were  $38^{\circ}$  F. and  $36^{\circ}$  F. respectively.

*Relative humidity.*—The relative humidity inside the shelter was approximately 25 percent; outside it was 23 percent. The higher relative humidity inside the shelter was probably due to transpiration and restricted air movements which prevented this moisture from being readily carried away.

*Wind.*—Ventilation of the greenhouses was by means of small vents located just under the roof. Air movements inside were thus minimal.

*Duff.*—The floor of the shelter was covered with partly decomposed aspen leaves, broken fern fronds, and other herbaceous ma-

*Continued on page 15*



Figure 1.—Charred strip in duff.



Figure 2.—Pool of water on greenhouse roof.

## DEER HUNTERS ARE CAREFUL WITH FIRE WHEN PROPERLY APPROACHED

DAVID D. DEXET, *Forester, National Forests in South Carolina*

What would you do if 9,000 deer hunters descended on your Forest and scattered over 800,000 acres during the driest October in 22 years? This was the problem facing the South Carolina Forestry Commission and the Sumter National Forest in the piedmont area of South Carolina in October 1963. Personnel of the South Carolina Wildlife Resource Department went "all out" to help.

A series of planning and strategy meetings with representatives from the Wildlife Resource Department resulted in many procedures to make the hunters conscious of fire prevention. Game wardens contacted and registered every hunter and asked their cooperation. Posters reminded hunters to be careful. Newspaper articles invited hunters to participate in organized hunts and requested their help in preventing fires. The South Carolina State



James W. Webb, Director of the South Carolina Wildlife Resource Department (left), receives citation from Forest Supervisor Ray W. Brandt of the National Forests in South Carolina for outstanding cooperation in fire prevention during the drought of October 1963, when 9,000 hunters visited the Sumter National Forest.



South Carolina for outstanding cooperation in fire prevention during the drought of October 1963, contacting a group of deer hunters in October 1963.

Forestry Commission conducted a series of TV and radio programs about the dry forests and hazards of fires.

U.S. Forest Service personnel conducted an intensive hunter contact program. The theme was: "You are welcome—come and enjoy yourself—this is your forest—the woods are extremely dry—please help us in preventing fires—we are confident you will be careful." Information concerning roads, hunter camps, and deer concentrations was provided. Game wardens helped organize drives and provided guidance and direction. The dry weather practically eliminated stalking.

*Continued on page 15*

## NEW SPARK ARRESTER LEGISLATION IN CALIFORNIA

The California State Legislature passed Senate Bill No. 643 at its 1963 session, and Governor Brown approved it on July 23, 1963. The sections pertaining to spark arresters follow:

Section 20. Section 4167 of said code is repealed. (Public Resources Code)

Section 21. Section 4167 is added to said code, to read:

4167. Except as provided herein, no person shall use or operate any internal combustion engine which is operated on hydrocarbon fuels on any forest, brush, or grass-covered lands without providing, and maintaining in effective working order, a spark arrester attached to the exhaust system. For the purposes of this section, a spark arrester is a device constructed of nonflammable materials specifically for the purpose of removing and retaining carbon and other flammable particles over 0.0232 of an inch in size from the exhaust flow of an internal combustion engine that is operated by hydrocarbon fuels. Motor trucks,

truck tractors, buses and passenger vehicles, except motorcycles, are not subject to the provisions of this paragraph provided the exhaust system is equipped with a muffler as defined in the Vehicle Code.

Provided, further, that spark arresters affixed to the exhaust system of engines or vehicles, as described in this section, shall not be placed or mounted in such a manner as to allow flames or heat therefrom to ignite any flammable material.

Provided, further, that all mobile equipment, including trucks, tractors, bulldozers, and other mobile equipment engaged in lumbering, logging, and other industrial operations in any forest, brush, or grass-covered land, shall also be equipped with and carry at all times a serviceable shovel for use in the prevention and suppression of fire, except that mobile equipment used in the business of a common carrier or railroad does not have to be equipped with or to carry a shovel for use in the prevention and suppression of fire.

## RETARDANT HOSE SKATE

GEORGE CARBERRY

*Wenatchee National Forest*

At a retardant base, up to three men are required to drag charged hose from aircraft to aircraft without hose skates. A hose skate which eliminates excessive wear on retardant transfer hose for filling air tankers was developed for the Wenatchee Air Tanker Base.

(See photographs.) With skates placed about 7 feet apart, one man can move a hose line easily. The cost of construction and materials is soon repaid in reduction of manpower and hose wear. One sheet of 4 by 8-foot plywood will make eight complete hose skates.

### *List of Materials*

<i>Item</i>	<i>Quantity</i>
3/4-inch outdoor plywood, 24×24×24 inches . . . . .	2 pieces
Lumber, 2×4×8 inches . . . .	2 pieces
5-inch ball-bearing rubber- tired casters . . . . .	3
3-inch conduit clamps . . . . .	2
5/16×7-inch bolts . . . . .	4
1/4×2 1/2-inch bolts . . . . .	12



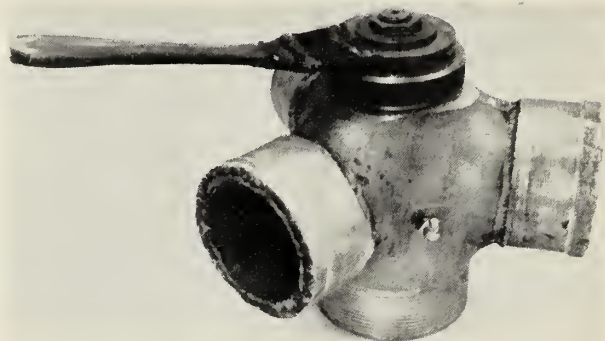
# MODIFICATION OF 3-WAY VALVE ON RETARDANT PUMPS

HORACE G. COOPER, *Fire Equipment Engineer,  
Pacific Northwest Region*

Here's how Region 6 solved a problem involving 3-way valves used on retardant handling pumps at air tanker bases. The 3-way valve is used on both the suction and discharge sides of retardant pumps. This valve permits adjustment of the nuts that attach the handle to the rotating plug. It is necessary to tighten the adjustment in the suction line to prevent air leakage. On the discharge side, the pressure often wedged the plug so tight that the valve became very hard to turn. As originally designed, the valves were hard to operate.

One manufacturer developed a modification of the valve so they could space the plug. This made the valves easier to work, but the plug attachment was still critical. If it was loose, it leaked air; if a little tight, it turned hard. Corrosion between the aluminum casting and the brass plug presented a problem.

We have installed a grease fitting in the valve to lubricate the plug, with a waterproof lithium-base grease. The grease fitting is placed about midway between two of the outlets and about midway



between the top and bottom of the valve (see photo).

With the grease fitting installed, the grease is forced in as the plunger is turned. Thus, the aluminum face of the casting and the brass face of the valve plug are coated with the waterproof grease. The treatment is effective in making the valves work easily, in stopping minor leaks of both air and retardants, and in preventing corrosion and sticking of the aluminum and brass parts of the valve.

---

## Forest Fires and Fire Weather—Continued from page 9

4. Approximately 10 frontal systems passed through the District in April. Generally the fronts were lacking in moisture content.

5. The surface winds associated with these dry frontal passages in April made the work of controlling fires more difficult.

6. The high temperatures and low dewpoints and relative humidities caused fuel moisture values to be as low as 3 percent on many days in April.

### Acknowledgements

We wish to thank the U.S. Forest Service Regional Offices at Upper Darby, Pa., and Atlanta, Ga., and the Southeastern Forest Experiment Station, Asheville, N.C., for furnishing the data in table 1, and the National Weather Records Center, Asheville, N.C., for most of the information in the figures.

---

## Unusual Cause of Fire—Continued from page 12

terial. The surface of the duff had been lightly disturbed by raking, and the light litter removed before the greenhouses were erected.

*Herbaceous plants.*—Scattered bracken ferns up to 23 inches high were the dominant vegetation in the shelter. Also found

were aspen suckers, wintergreen, and bindweed. Density of the plant cover was never sufficient to provide heavy shading of the duff.

---

## Deer Hunters—Continued from page 13

This outstanding cooperation among the hunters, State organizations, and the Forest Service resulted in an almost perfect record. Only one small fire occurred

during the entire season, and it was quickly extinguished by hunters and game wardens. Thus, intensive personal contact, use of cooperating agencies' personnel,

mass media appeals, and welcoming the hunters and expressing confidence in their care with fire paid big dividends.

The April '64 Fire Control Notes contained an article, "Use of Air Pressure Powered Water Tanks in West Tennessee," which described a simple low-cost slip-on forest firefighting tanker. It has been called to our attention that industrial safety codes in some states prohibit the use of certain types of water tanks in air-pressure discharge systems. Persons contemplating construction of pressurized water tanks should follow local industrial safety codes to ensure that proper tank types and appropriate pressure relief valve systems are used.

## PROPANE GAS INSTALLATION FOR LOOKOUT TOWER

HOWARD BURNETT, *District Ranger,  
National Forests in North Carolina*

Provision of utilities at isolated lookout tower installations has long been a "bugaboo" for fire control supervisors. Albert Mountain Lookout on the Wayah Ranger District of the National Forests in North Carolina presented such a problem. Heating and cooking were done with wood stoves, lighting was by means of kerosene lamps, and there was no refrigeration.

When modernizing this tower, the decision was made to convert to a propane gas system. For a total charge of \$701.90 a local propane gas company furnished and installed a 500-gallon propane tank; gas piping, valves, etc., to the tower cab; two 50-watt equivalent gas lights; a 60,000 B.t.u. vented heater; and a 2-cubic-foot refrigerator and 3-burner gas stove combination unit.

An alternative to the gas installation was to run a powerline about 5 miles cross-country, and provide a complete electric installation, at an estimated cost of \$10,000. A gas installation is by far the less expensive of the two. In addition to the cost savings compared with electric power at this location, other advantages over wood or coal fuel are compactness; cleanliness, no ashes or wood

chips; faster and easier cooking; refrigeration; and elimination of cutting, hauling, and storage of fuel.

The gas is purchased from a local propane supplier for 20¢ per gallon. We use about 500 gallons of the gas per year, costing us about \$100. The 500-gallon tank requires only one refill trip per year. Because of the rough road to Albert Mountain, passable in dry weather, it may be feasible to locate the tank some distance from the tower.



766Fi  
b.2

October 1964

Vol. 25, No. 4

# FIRE CONTROL NOTES

U. S. DEPT. OF AGRICULTURE  
NATIONAL AGRICULTURAL LIBRARY

NOV 20 1964

CURRENT SERIAL RECORDS

U.S. Department of Agriculture  
Forest Service



# FIRE CONTROL NOTES



*A quarterly periodical devoted to forest fire control*

## CONTENTS

<i>Page</i>	<i>Page</i>
3 Developing a network of fire-danger stations JOHN J. KEETCH	11 Helmet rack PHILIP E. CLARKE
5 Experiences with the one-man flail trencher FRANCIS B. LUFKIN	12 Stabilization of slash fuel samples S. J. MURARO
7 The new Bowles helitank RALPH A. JAMES	13 Tragic fire toll itemized at meeting DALLAS TIMES HERALD
9 Brush clearance for structural protection HARVEY T. ANDERSON	14 Drafting table for field projects CLEMENT MESAVAGE
	15 Index, 1964

## INFORMATION FOR CONTRIBUTORS

Please submit contributions through appropriate channels to Director, Division of Fire Control, Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250. Articles should be typed in duplicate, double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and organization.

Authors are encouraged to include illustrations with their copy. Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints or India ink line drawings are acceptable. Captions for illustrations should be typed in the manu-

script immediately following the paragraph in which the illustration is first mentioned, the caption being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the caption to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

COVER—This flail trencher is being used to quickly build a fireline.

FIRE CONTROL NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D.C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. Use of funds for printing this publication approved by the Director

of the Bureau of the Budget (Sept. 16, 1963).

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, 20 cents a copy, or by subscription at the rate of 75 cents per year, domestic, or \$1.00, foreign. Postage stamps will not be accepted in payment.

# DEVELOPING A NETWORK OF FIRE-DANGER STATIONS

JOHN J. KEETCH, *Research Forester (Fire),*  
*Division of Forest Protection Research,*  
*Washington Office (located at Asheville, N.C.)*

*Editor's Note:* The future availability of automatic weather observation systems will permit the selection of fire danger station locations which were previously not practical. It will be possible to place observation stations at midslope and in critical fuels; they will not be restricted to valley floors or ridgetops. To meet the increased need for guides on spacing between stations, a summary and suggested minimum standards for spacing of fire-danger stations is presented.

## Introduction

There is no clear-cut answer to the spacing of fire-danger stations (fig. 1). This article summarizes a few references and a discussion with research personnel at the National Weather Records Center, Asheville, N.C. Because of the complexity of the problem, even the broad agreement in recommended spacing is rather surprising and encouraging.

## Recent Opinions

In writing under the heading "*How Many Stations?*" Nelson made the following statement.<sup>1</sup>

<sup>1</sup> Nelson, R. M. How to measure forest fire danger in the Southeast. U.S. Forest Serv. Southeast. Forest Expt. Sta. Paper 52, 22 pp. 1955.

"There can be no specific answer to the question, 'How many danger stations should I operate?'. Differences in topography, weather, fire occurrence, size of administrative divisions, and patterns of land use are the major variables that have to be evaluated before a sound decision can be reached. Basic to such evaluation are maps of administrative units differentiated into zones of weather, fire occurrence, and danger measurements from well located and operated stations.

". . . In USDA Handbook No. 1, one station was suggested for 150,000 acres in the mountains and one for 300,000 acres in rolling or flat country . . ."

Use of these acreage figures would result in a *desirable* spacing of about 17 miles between stations in mountains and about 25 miles between stations in flat or rolling country. Nelson also suggests that a *fair* network of stations would still be provided if the spacing were about 30 miles in mountains and about 42 miles in flat country.

The results of investigations in Canada on the reliability of danger ratings with distance from station give a little more leeway. In an analysis of fires in New Brunswick, Beall<sup>2</sup> concluded as follows:

- Within a radius of 25 miles the danger index is highly reliable.
- At distances between 25 and 100 miles the danger index may be useful, but is not highly reliable.
- At distances greater than 100 miles weather conditions are apt to be so different as to make the danger index quite unreliable.

Similar conclusions were drawn by Williams<sup>3</sup> in a study conducted in the plateau region of British Columbia. In another recent report Williams<sup>4</sup> states the case as follows:

<sup>2</sup> Beall, H. W. Forest fires and the fire danger index in New Brunswick. *Forestry Chron.* 26(2). 1950.

<sup>3</sup> Williams, D. E. Fire danger rating and fire experience in the Cariboo. *Brit. Columbia Lumberman* 47(3): 12, 14, 16, 18. 1963.

<sup>4</sup> Williams, D. E. Forest fire danger manual, Canad. Dept. Forestry Pub. 1027, 28 pp. 1963.



Figure 1.—Fire-Danger Station at Hungry Horse, Mont. (Flathead National Forest).

“ . . . If the earth were as flat as the top of a table, as indeed it is in some areas of our country, a single weather station would provide weather data representative of a relatively large area. On the other hand, in mountainous country, fire weather varies from valley to valley, from one elevation to another, and from one aspect to another. In certain parts of eastern and central Canada, where topographic conditions fall somewhere between these extremes, it has been found that fire danger ratings from a given station are reliable for a *radius* of about 25 miles. For points 50 to 60 miles from the station, ratings, although less reliable, have still proved to be useful. In general, then, each fire-weather station should not be expected to cover an area having a radius of more than 25 miles, and in mountainous country the number and extent of individual valleys will be a better indication of the number of stations needed.

Since rain is the weather factor most likely to vary from place to place within the area to be served by the station, it is often advisable to measure rainfall at one or more auxiliary locations and to use these rainfall records, together with other required weather readings from the main station, in working out the danger index for additional localities.”

Thus, Williams believes that stations spaced 50 miles apart will give adequate coverage in average country and that the network should include additional measurements of the more variable factors, such as precipitation.

The 1960 *Guide to Climatological Practices*,<sup>5</sup> prepared by the Secretariat of the World Meteorological Organization, is of greater interest. The relevant parts are the section on “*Climatic Elements and Their Observation*” and the subsection on “*Networks*.” The “ideal” network of stations is described as follows:

“Ideally, the number of stations at which any particular climatic element is observed should be large enough to permit a complete analysis to be made, without resorting to doubtful hypotheses, of the geographical distribution of mean values, frequencies, extremes, and other characteristics of this element.

“ . . . A sparse network may be sufficient for the study of the atmospheric pressure reduced to sea

level but, on the other hand, a fairly dense network will normally be required for the study of the wind regime (exposure) and such elements as maximum temperature, amount of precipitation, and number of days with snowfall, and a very dense network may be required for the study of minimum temperature, frequency of frost, and frequency of fog.”

The WMO report recognizes the marked tendency for isolines of the values of most climatological elements to be parallel to the major broad-scale geographic boundaries, such as coastlines or mountain chains. A similar but smaller influence is noted in hilly country. For an adequate study of these relationships, the report recommends climatological stations 1 to 6 miles apart if they are alined perpendicular to the coastline, mountain range, or valley bottom, and 12 to 31 miles apart if they are alined parallel to such boundaries.

The report further specifies that in areas where the geographical conditions are fairly uniform, a station per 1,000 square kilometers will normally be sufficient for most climatological purposes. This means a station per 625 square miles, one per 400,000 acres, or one 30 miles from the next station.

I believe that these requirements presented by the World Meteorological Organization are somewhat more rigid than those usually needed in fire control planning. In table 1 I have indicated the minimum stations that I believe are necessary.

TABLE 1.—*Minimum standards for spacing and density of fire-danger station network*<sup>1</sup>

Terrain	Average distance between stations	Average density per million gross acres
	<i>Miles</i>	<i>Number</i>
Flat to gently rolling country . . .	40–50	1
Broken and hilly country . . . . .	30–35	2
Mountainous terrain . . . . .	20–25	4

<sup>1</sup> Depending on local needs, additional stations may be necessary in certain areas, or additional measurements of selected fire-weather factors may be needed.

The station-spacing problem was discussed early in 1964 with Dr. Gerald Barger, Director, National Weather Records Center, and four members of his

*Continued on page 6*

<sup>5</sup> World Meteorological Organization. *Guide to Climatological Practices*. No. 100. TP 44. 1960.

# EXPERIENCES WITH THE ONE-MAN FLAIL TRENCHER

FRANCIS B. LUFKIN, *Aerial Project Officer,*  
*Okanogan National Forest*

*Editor's Note:* Fire control men are constantly looking for new and better ways of doing their work. For example, mechanized fireline trenchers have been developed, discarded, and redeveloped during the past several years. In this article, Mr. Lufkin writes of his personal experiences with the one-man flail trencher. An interim specification, No. 5100-00370, was adopted by the U.S. Forest Service for this trencher in June 1964. The specification is available on request from the Chief, U.S. Forest Service, Washington, D.C.

The size of our aircraft (Twin-Beech<sup>1</sup>) limits our basic mechanized line building crew to four men. One man is the chain saw operator, the second man cleans up behind the saw, the third man operates the trencher (fig. 1), and the fourth man cleans up, finishes the fireline, and maintains the supply of gasoline, water, and chain oil for the crew. The chain saw man is the most important man in the operation because he sets the pace for the line building operation. However, all of the men should be trained to work at all of the positions.

Mechanical equipment does not have a place on all fires, but it should be ready and available for

use as needed. Mechanized equipment can be integrated into any size of crew without difficulty. The amount and type of equipment varies with topography and fuel type.

Trenchers have also been valuable in mopup and in cooling hotspots. Exposed fire on logs and stumps is knocked down much quicker with a trencher than it is knocked down with a shovel or chopped off with a pulaski (fig. 2).

## CASE HISTORIES OF TRENCHER USE

### 1. Found Creek fire—Mt. Baker—1959

Our first mechanical trencher was used on this fire. It was equipped with a star blade head of our design. The eight-man crew used it in their mopup. The crew boss said that "although it only lasted 20 minutes, it was doing as much work as the rest of the crew." This was encouraging, so we built an improved head for the machine.

### 2. Beaver Lake fire—Okanogan—1960

This was a Class E fire which had a heavy lodgepole fuel type, with excessive down lodgepole. We had an 18-man initial attack crew, with four chain saws and one trencher equipped with an improved star blade head. We used 15 men out front to remove the heavy lodgepole downfall. One man using the trencher did nearly all the trench digging, with two men cleaning up behind. The

<sup>1</sup> Use of trade names is for information purposes and does not imply endorsement by the Forest Service.



Figure 1.—The flail trencher in operation.

## FLAIL TRENCHER ATTACHMENT

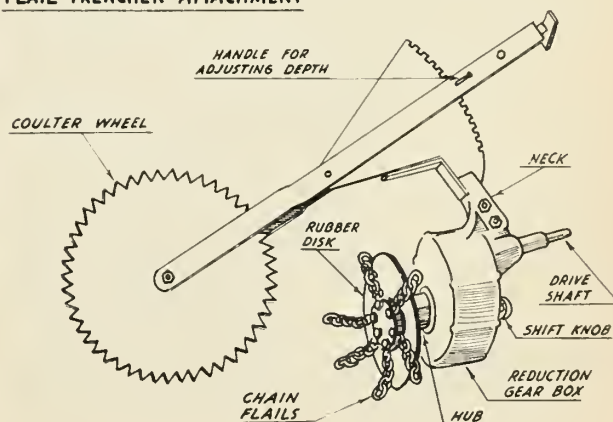


Figure 2.—A diagram of the flail trencher attachments.

crew built about one-fourth mile of fireline the first afternoon and night that the fire burned.

### 3. Lightning Creek fire—Okanogan—1961

This was a grass fire with scattered pine and fairly rocky topography. We dropped a four-man crew with two trenchers, equipped with the first chain type of flail heads. These four men built more than 160 chains of fireline in about 10 hours. They found that operating the machines in tandem provided the best efficiency.

### 4. Ortell Creek fire—Okanogan—1962

This fire burned in scattered pine, with a pine-grass cover. The soil was perfect for the flail trencher. We had an eight-man crew with trenchers and one chain saw. We had an excellent line around the 1-acre fire in 30 minutes. We then plowed up the whole burned area. We used the flail to beat the fire off the logs, and then we threw a dirt covering over everything. The fire was reduced to a few smokes in about 2 hours. The trenchers speeded the mopup immensely.

### 5. Baldy fire—Okanogan—1962

We dropped 19 men on this fire, which was controlled at 100 acres. The fuel type was heavy lodgepole, stacked head high in places. We used four chain saws and two flail trenchers. We built a line approximately two-thirds the way around the fire (approximately 10 acres at this time) be-

fore it blew up. The trenchers could be operated by just two men. This was important because the remainder of the crew were free to do the extensive sawing and clearing. Using the dirt-throwing action of the flail, we ran across the top of the fire, cooling it and holding it for some time.

### 6. Volstead Creek fire—Okanogan—1964

We dropped four men on this 1½-acre fire, along with one chain saw and one flail trencher. The fuel type was scattered pine and pine grass, and the topography was quite rocky. In 1 hour the trencher had gone around the fire twice, and a very good fireline had been built. While the trencher operator built the fireline, the other three men knocked down hotspots and cut snags.

## OTHER USES

We have used the flail trenchers on other jobs. We obtained fairly good results by using them to scalp ahead of tree planting crews. We used them in erosion control to cut small drain ditches in skid trails.

Flail-trenchers are effective for building control lines around cutting units prior to burning. Many people on the Okanogan National Forest feel the hand trench has application in prescribed burning because use of the "cat line" causes so much erosion on the steeper areas. These extra projects enable our smokejumpers to obtain good training in handling mechanized equipment while performing useful work.

---

## Fire-Danger Stations—Continued from page 4

staff. Dr. Harold Crutcher, Chief of the Science Advisory Staff, reported, as an example, that monthly average temperature correlations rated against Miami, Fla., dropped to 0° F. at 600 miles, but maintained a 95-percent correlation for as far as 100 miles. In the Central United States the 95-percent level was maintained up to 95 miles. However, these limits should be used only where the primary interest is obtaining statistical data, such as broad approximations of seasonal severity. Stations spaced up to 200 miles apart might be useful for this limited purpose, but they would not satisfy daily operational needs.

Personnel of the National Weather Records Center knew of no reports that would provide better clues as to optimum fire-danger station distribu-

tion; however, they propose to look further. They thought that the 25-mile radius suggested by Williams was a reasonable first approximation in certain terrain, particularly if supplemented by additional rain-measuring stations.

## Conclusion

We have only an approximate answer to the question of fire-danger station distribution. The development of a station network for a fire control organization is largely a rule-of-thumb procedure. The suggested minimum standards should be helpful, but they are not the best answer. Analyses of weather records combined with the results of local climate studies now underway at several experiment stations should eventually provide a sound basis for the optimum spacing of fire-danger stations.

## THE NEW BOWLES HELITANK

RALPH A. JAMES, *Assistant Regional Coordinator,  
Northern California Service Center, Redding, Calif.*

*Editor's Note:* The Bowles Helitank is designed to attach to the "H" frame adapter developed at the Arcadia Equipment Development Center.

### *Description*

The new Bowles helitank<sup>1</sup> is square, open topped, and constructed of heavy-duty coated fabric. Its capacity is approximately 90 gallons of liquid for small helicopters (Bell G3B or Hiller 12E<sup>2</sup>) without leg extension or 100 gallons of liquid when attached to the above helicopters with leg extension. Recommended gross weight limitations must be followed for each helicopter make and model (fig. 1).

### *Rigging*

The helitank is suspended on the rails of the bomb shackle adapter assembly by parachute webbing. The webbing straps are lashed around the rails of the adapter assembly, and attached by hooking the parachute snaps at the end of the straps into the V-ring sewn to the bag (fig. 2).

<sup>1</sup> The helitank was developed by William Bowles, Supervisory Smokejumper and Master Parachute Rigger, and Ralph Johnston, Helitack Specialist, of the Northern California Service Center, Region 5. Bert Train, Helicopter Operator, and Charles Burgans, Helicopter Pilot, assisted with the development and testing of the helitank.

<sup>2</sup> Use of trade names is for information purposes and does not imply indorsement by the Forest Service.

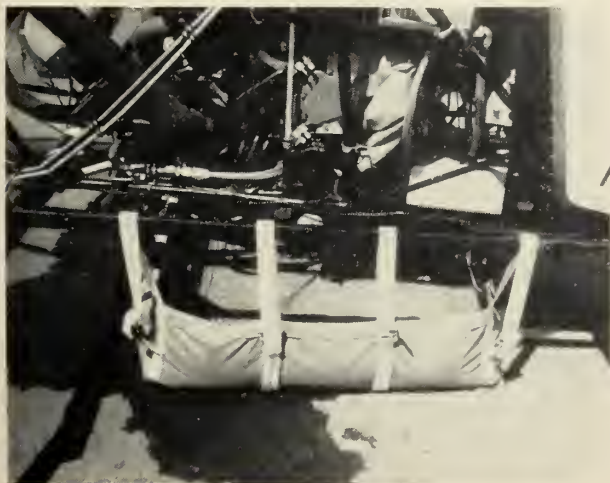


Figure 1.—Bowles helitank attached to bomb shackle adapter assembly on Bell helicopter with leg extension.

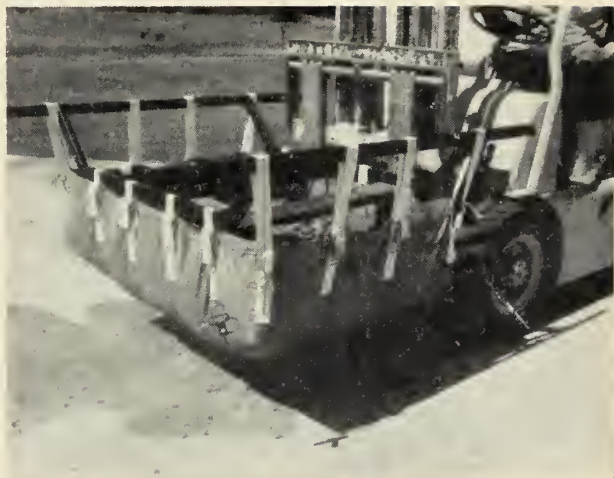


Figure 2.—Bowles helitank showing rigging to bomb shackle adapter assembly.

### *Dropping*

The pilot may release the contents of the tank electrically or manually (fig. 3). When the helicopter is over the target, the pilot hits the release switch which supplies the current from the helicopter's electrical system to the electric solenoid mounted on the bomb shackle. The solenoid opens the bomb shackle, releasing the spout. The tank empties in 3 seconds.

Flying at 30 miles per hour and 50 feet high, the drop pattern with water is 30 feet wide and



Figure 3.—Static tests of dropping time with Bowles helitank.

100 feet long (fig. 4). After the drop is completed, the tank remains snug against the bomb shackle adapter assembly at cruising speed. Pilots report no adverse effects on flight characteristics before or after dropping.

### *Advantages*

The Bowles helitank has the following advantages over helitanks now in use:

1. *The exchange of equipment.* When helitacks with rigid tanks are made, it is necessary to remove the helitank and attach the bomb shackle adapter assembly if the fire manager decides to use other helicopter accessories such as a helipumper, sling load, or hose tray. This is a 20- to 30-minute job. With the Bowles helitank, the bomb shackle adapter assembly is already in position for attaching other helicopter accessories.

2. *Easier handling and transportation.* One man can easily attach or detach this tank and fold it into a small bundle. It can be kept on the cargo rack of the helicopter. The rigid aluminum helitanks now in use require at least two men to mount or demount and a pickup to move the equipment.

The Bowles helitank weighs approximately 15 pounds, compared to approximately 50 pounds for aluminum tanks. This reduced weight allows an increase in the helicopter payload.

3. *Less expensive.* The cost of the Bowles helitank is about \$60, compared to \$500 to \$1,200 for rigid aluminum tanks. It is also inexpensive to replace.

4. *More adaptable.* The Bowles helitank can be attached to a Bell or Hiller helicopter adapter assembly regardless of leg height. Metal tanks are not interchangeable without major modifications and resulting expense.

5. *Easier maintenance.* The Bowles helitank is easily repaired if damaged on the fireline.

6. *No certification.* A Supplemental Type Certificate is not necessary for the new helitank since it is attached to the bomb shackle adapter assembly that is certificated by the Federal Aviation Agency.



Figure 4.—Drop pattern made with Bowles helitank; it is 30 feet wide and 100 feet long.

Material lists, plans, and specifications are available from the U.S. Forest Service, Northern California Service Center, Airport Road, Redding, Calif.

### MATERIALS LIST

#### Tank

Material, Herculite 80 coated fabric

Physical properties:

Total weight, 18.1 sq. yd.

Tensile strength:

Warp, 332 lb. per in. width

Fill, 338 lb. per in. width

Tear strength:

Warp, 103 lb.

Fill, 108

#### Webbing

Nylon webbing straps, white

Spec. Mil W 4088, type 8, 1¾-in. wide

Condition (untreated) natural

Tensile, 3,600 lb.

Price per 100 yd.

Natural, \$22.58

#### Snaps

Parachute snaps tested to 2,500 lbs.

## BRUSH CLEARANCE FOR STRUCTURAL PROTECTION

HARVEY T. ANDERSON, *Division Assistant Fire Chief*

*Los Angeles County California Fire Department*

Many structures have been lost in brush fires in southern California in 11 of the last 35 years. However, homes amid the worst brush fire can be saved if the surrounding brush is cleared.

Brush fires classified as major conflagrations repeat the same burning pattern on about a 20- to 30-year cycle. While fires of such magnitude constitute less than 3 percent of the total fires occurring in the watershed, they do by far the most damage. These fires can and do occur during all seasons.

Firefighters have worked on the flanks of these fires, reduced the acreage burned, and saved many structures in the paths of the fire, but until the extreme wind decreased or the fires consumed all available fuels, it was impossible to build control lines around them. Most of the structures lost had little or no brush clearance.

One hundred acres of fire in heavy brush releases the same B.t.u.'s as one atomic bomb, Hiroshima size. Nature could hardly have designed a more explosive mixture than the half-dead, oil-filled, finely divided leaves and stems of the vast brush fields of southern California chaparral. Add to this a carpet of dry grass for a fuse, and there is a potential conflagration from any one of a dozen causes.

The Indians put their teepees in the open grass meadows and let the children and dogs wear the ground bare. When the fires approached, they did not burn their homes.

American homeowners have been slow to realize that when the brush is too close to the house, the house is very likely to burn when a brush fire occurs. The Topanga fire of 1958 demonstrated this fact convincingly. In Fernwood in Topanga, 50 homes burned in a dense brush area, while on Big Rock Mesa, where the brush had been removed from around the homes, not one home was lost. This does not mean that homes need not be protected from flying embers or that fire engines are not necessary. It does mean that firemen and their equipment can certainly do a better job of saving homes if the house is not buried in flammable brush.

The fire problem on the average summer day

has been solved in most of southern California. With the abundance of pumpers, patrol pickups, bulldozers, airplanes, and manpower, the average fire does not usually get out of control.

It is the fire that starts during high winds and low humidities and becomes large that greatly damages watersheds and homes. This conflagration runs until it consumes all available fuel or the wind abates. Nothing can be done about the wind, so what can be done about the FUEL? For effective fire control under conflagration conditions, reduction and modification of the fuel is needed.

In 1956 there were three big fires in Malibu, all driven by high winds in rough country. These fires occurred in a 6-day period and burned some 37,000 acres. All three practically duplicated fires that burned in 1930, 1935, and 1943.

Civic organizations became incensed and insisted that the fire department do something. The Chambers of Commerce of Topanga and Malibu insisted that the fire services recommend a solution. Interested parties met in 1957 in Los Angeles County Supervisor Chace's office, and as a result of this meeting, the Los Angeles County Brush Clearance Ordinance was adopted.

In 1959, clearing of lots was begun. The County Fire Department tries to get the property owner to make his own 100-foot brush clearance, but if he does not, the County crews clear his property and add the cost to the owner's tax bill. The average cost per lot cleared by County crews has been \$100. When the owner can be contacted, an average additional cost of \$5 is charged for chemical spraying. These sprays eliminate the need to cut the brush back the following year.

To remove the brush hazard, the Los Angeles County Fire Department uses the authority given by the 1961 Weed Abatement Act, State Health and Safety Code Section 14875-14921. In January, the County Board of Supervisors declares that certain lots are fire hazards and must be cleared. Weed Abatement Section personnel post brush hazard removal signs on these lots, and fire station captains and patrolmen try to obtain voluntary action. If the brush has not been cleared by August, a 30-day notice is sent to the owner, and if the work is not

done by September 15, the County crews start cutting. Hand crews burn the piled brush, or if the weather is unfavorable, the brush is run through a chipper and distributed on top of the soil as a mulch.

The Brush Clearance Ordinance has been declared constitutional when owners have tested the law in court. Insurance companies have required up to 400 feet of clearance in some brush areas to prevent a brush insurance surcharge. The insurance companies have helped greatly in getting people to meet the requirements of the Brush Clearance Ordinance.

Instead of telling citizens to clear all the brush off his property, the slogan "Landscape with the native vegetation" is used to promote individual effort.

Some owners have found, after clearing off brush, that they owned more valuable land than they thought. After the 1961 Topanga fire, many personally thanked the Fire Department for making them clear the brush around their homes.

The effort is to reduce the fuel by separating bushes so that fire will not readily travel from one to the other, and to create a pleasing parklike effect. The use of local shrubs, such as manzanita, sumac, holly, scrub oak, or lilac, all native to the dry southern California climate, simplifies the plant problem. The remaining plants will have deep root systems and along with the grass and weeds that will come in will give the erosion protection that is needed.

The use of bulldozers for clearing brush in steep terrain is not advised. Hand clearing is necessary so that the duff and leaf mold will be left to protect the soil. No soil erosion was found after a heavy rain in the first brush area cleared in Fernwood in Topanga Canyon. Where water is available, low-lying iceplants and ground cover plants can be used to protect the soil and beautify the area. The department has a list of suitable plants.

### *Controlling Regrowth*

The new 6- to 8-inch spring growth is treated with a mixture of 50-percent concentrate composed of 1½ oz. 2-4-D, 1½ oz. 2-4-5-T, and 3 gal. of water. Twice this strength was used on 3,000 acres on the

Temescal Ranch, and an 85-percent brush kill was obtained. The cost was approximately \$14.50 per acre. This figure included the expense of application by helicopter. One good mix for the treatment of 1 acre is 3 lb. of 2-4-D, 3 lb. 2-4-5-T, and 1 gal. of diesel oil; water is added to make 10 gal. of mix.

For sagebrush, 3 lb. of 2-4-D, 1 gal. of diesel oil, and enough water to make 10 gal. of mix is effective. The cost is approximately \$7.65 per acre when the mix is applied by helicopter. Application of sprays around houses or cultivated areas must be done with extreme care under conditions of no wind to prevent damage to other plants.

Prescribed burning has been advocated by some as a means of breaking up the large brush areas, but it is not feasible in southern California. It is not possible to both do it safely and obtain a good burn.

However, advantage should be taken of the burns that do occur and the areas treated to prevent regrowth of the brush on main ridges in selected areas. We need to perfect regrowth control methods. Some erosion may have to be tolerated, but it is better to have some erosion than to permit the repetition of the 30-year cycle of devastating conflagrations, the loss of valuable watersheds and homes, and the subsequent disastrous floods and accompanying erosion.

### *References*

The following pamphlets and bulletins may be of help in further investigation of this subject.

Los Angeles County Fire Department.

1960. Can your home survive a major brush fire?

1964. Chemical control of brush around the home. Murphy, J. L.

1963. Conflagration barriers. Pacific Southwest Forest and Range Expt. Sta., 12 pp.

Pacific Southwest Forest & Range Experiment Station, California Division of Forestry, and Los Angeles County Fire Department.

1963. Guidelines for fuel breaks in So. California. Fuel Break Rpt. 9, 25 pp., illus.

Plum, T. R., Bently, J. R., and White, V. E.

1963. Chemical control of brush regrowth on fuel breaks.

Pacific Southwest Forest and Range Expt. Sta., 41 pp., illus.

## HELMET RACK

PHILIP E. CLARKE, *Supervisory Smokejumper*

*Bureau of Land Management, U.S. Department of the Interior, Fairbanks, Alaska*

The Alaska smokejumper unit was established in 1959, on a trial basis, to increase the efficiency of forest and range fire control in Alaska.

In growing from a 16-man contingent in surplus quonset huts to a well-equipped 50-man fire suppression organization, we have encountered many problems, some *unique* to Alaska, some common to all growing smokejumping units. One problem which has plagued all loft foremen is how to store smokejumper helmets so they will be orderly arranged and safe from damage while in storage.

To meet this problem we have constructed a simple and efficient helmet rack. The helmets are placed on the rack; the ear vents are inserted onto a welding rod hook (fig. 1). The individual racks are spaced to allow easy accessibility to each helmet when the rack is fully loaded (fig. 2).

The racks are made of  $\frac{3}{4}$ -inch thin-wall conduit and 5-inch pieces of  $\frac{1}{8}$ -inch steel welding rod. The racks consist of 5-inch pieces of welding rod placed at 10-inch intervals starting 12 inches from the bottom of the rack. The welding rods are bent upward

to a 60-degree angle to give the helmets a stable resting position (fig. 3).

In addition to improving the appearance of the storage area and decreasing the storage damage of the helmets, use of the helmet rack has increased the available shelf space.



Figure 1.—Smokejumper helmet in storage on helmet rack. (Photo courtesy of U.S. Department of Interior, Bureau of Land Management.)

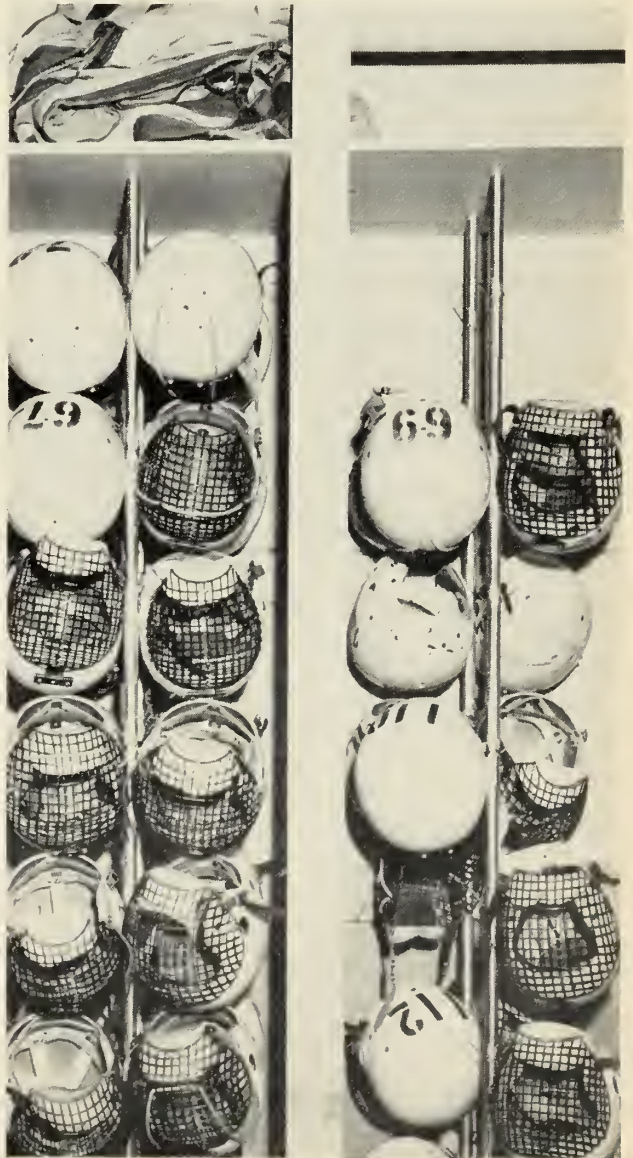


Figure 2.—Helmet rack installed in parachute loft. (Photo courtesy of U.S. Department of the Interior, Bureau of Land Management.)

*Continued on page 16*

# STABILIZATION OF SLASH FUEL SAMPLES

S. J. MURARO, *Research Officer*

*Forest Research Branch, Department of Forestry  
Victoria, British Columbia<sup>1</sup>*

In fire research, sampling of highly diverse fuels such as slash is difficult, particularly if preservation of the spatial distribution is desired. One method of sampling such fuels is to stabilize them in their original state by using Vibrafoam.<sup>2</sup> It is a rigid polyurethane foam similar in appearance and physical properties to styrafoam.

Vibrafoam is marketed as a two-package viscose liquid; part A contains the prepolymer and part B, the cross-linking agent, catalyst, and blowing agent.<sup>3</sup> Combining the liquids in the ratio of 11 parts B to 10 parts A by weight or 8 parts B to 7 parts A by volume produces a foaming liquid which rapidly hardens to form a porous, white mass. Two quarts, one of part A and one of part B, yield approximately 3.3 cubic feet of foam at a cost of about \$10. Larger quantities are available at lower prices.

Small quantities of the two liquids are combined in the appropriate ratios and mixed with an egg-beater or by rapid hand stirring in a polyethylene mixing bowl. (Polyethylene lessens adhesion of solidified foam to the mixing vessel.) Within 1 minute the liquid will expand to form a yellowish froth. This froth is poured through voids in the slash to form a mound of froth at the base of the fuel. Further expansion of the froth incorporates fuel components both vertically and horizontally until the action of the blowing agent is exhausted and hardening commences. This procedure is repeated until a mound of rigid foam incorporates the desired portion of the fuel complex. Safety precautions furnished by the supplier should be observed, especially regarding fume inhalation.

Within 30 minutes the foam solidifies, and a sample (fig. 1) may then be obtained by making



Figure 1.—Fuel sample stabilized with Vibrafoam.

four vertical saw cuts along the borders of the desired sample. The complex of Vibrafoam and entrapped slash is easily cut with a handsaw, but if the incorporated fuel components are large, a chain saw may be required. Attempts to cut similar samples of slash without the benefit of a stabilizing medium have been time consuming and difficult.

The method of evaluating the incorporated fuels will depend on the fuel information desired. Average density of a fuel sample may be calculated by determining the difference between (a) the density of foam plus incorporated fuel components and (b) the density of an equal volume of solidified foam. The total weight of fuel is the product of the difference in densities and the volume of the sample.

If a finite description of the distribution of fuel sizes and types is desired, the sample may be sectioned to isolate specific zones. Figure 2 shows two facing sections cut from the sample shown in figure 1 and the larger fuel components which were later extracted from the sample.

<sup>1</sup> Department of Forestry, Canada, Forest Research Branch Contribution No. 462.

<sup>2</sup> Use of the trade name, Vibrafoam, is solely for information purposes, and endorsement by the Forest Service is not implied.

<sup>3</sup> Anonymous. Naugatuck Chemicals Technical Data Bulletins, P<sub>1</sub>, P<sub>2</sub>, and P<sub>5</sub>, Naugatuck Chemicals, Elmira, Ontario.



Figure 2.—Adjacent sections of the sample shown in figure 1. The larger fuels taken from each section are shown below.

To allow examination of the incorporated fuels, they must be separated from the foam by breaking

the section and removing the larger fuel components by hand. Smaller fuel components, such as needles, grass, and fine twigs, may be separated by dissolving the foam in a solution of equal parts of acetone and dimethyl formamide or in methyl alcohol. Each fuel component can then be dried and weighed to permit a description of the fuel complex in terms of the spatial distribution of weight, or in terms of fuel surface area.

## VIRGINIA HARD HIT BY '63 FOREST FIRES

Fires destroyed 44,744 acres of Virginia's forests last year, the State Division of Forestry reported. It was the worst year for forest fires since 1952, when 111,000 acres of forest land were burned over.

Hardest hit was the Northern Piedmont section of the State, where 545 fires burned 9,529 acres.

## TRAGIC FIRE TOLL ITEMIZED AT MEETING

*[From the DALLAS TIMES HERALD, Dallas, Tex.,*

*May 19, 1964.]*

Percy Bugbee, general manager of the National Fire Protection Association, detailed the toll of human suffering and waste caused by fire in his report to the organization's 68th annual meeting in Dallas, Tex., in May 1964.

On an average day, 32 people will be killed by fire, more than 1,500 homes will be hit by fire, costing homeowners nearly \$1 million. There will be fires in 14 schools, 17 farms, 3 hospitals, and 8 churches. Fire will disrupt operations in 135 factories and 120 stores.

"These are not just numbers," said Mr. Bugbee. "These are people and their possessions and their jobs—all casualties of needless fires."

He emphasized that practically every fire is needless.

"Dig into the story of every fire and there is

some human failure or act of carelessness which allowed the fire to happen.

"Fire cost 11,800 lives and more than \$1.7 billion in property damage in 1963 in this country, and it may appear we are losing ground.

"However, our growth in population during the past 25 years means there are many millions more people exposed to the hazards of fire. Likewise, there are tens of billions of dollars' worth of additional property available to burn. So actually we have made progress in holding losses to their present levels.

"But in the final analysis, it is people who cause fires. When all of us acknowledge that fires are not only wasteful but avoidable, and then go on to reform the habits and remove the hazards that cause them, we will see real progress," he concluded.

## DRAFTING TABLE FOR FIELD PROJECTS

CLEMENT MESAVAGE, *Research Forester*  
*Southern Forest Experiment Station*

A combination drafting and light table that can be placed on a desk prior to use or stored when not in use has been constructed (figs. 1, 2).

A 32- by 40-inch drawing surface is attached to a 28- by 36-inch base, 7 $\frac{3}{8}$  inches high. The table's height is 9 $\frac{1}{8}$  inches; this dimension can be altered to suit the user. A full-length piano hinge is installed at the front. This allows the user to tilt the table at various angles. Casement sash adjusters are used at the rear corners to lock the table in place at the desired angle.

A 24- by 30-inch frosted plate glass is recessed flush, centered in the surface of the top. Even illumination is provided by two fluorescent fixtures, each containing four 20-watt tubes. A sheet of chromed brass set under the tubes reflects light upward.

The tabletop was made from a solid-core veneered door, 1 $\frac{3}{4}$  inches thick, and faced with birch (maple or another close-grained hardwood would be equally suitable). An opening, 23 $\frac{1}{4}$  by 29 $\frac{1}{4}$  inches, was sawed out, and then a  $\frac{3}{8}$ -inch ledge was routed deep enough for flush mounting of the glass. The glass was fixed in place with a glazing compound. A 36-inch parallel rule was attached.

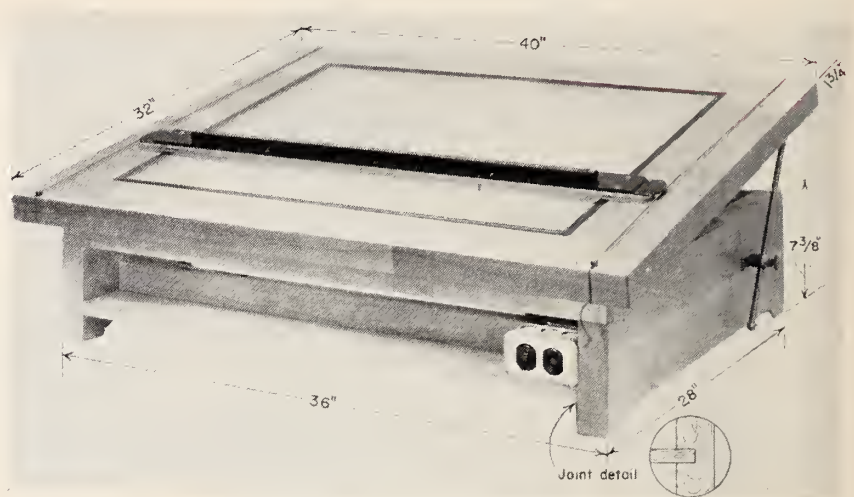


Figure 1.—Completed drawing table.

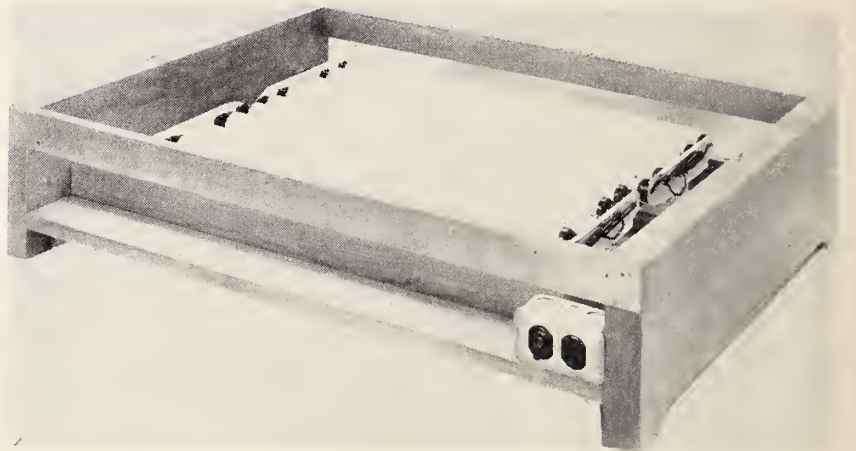


Figure 2.—Top removed to show installation of light fixtures.

Sides of the base were ripped from the material removed for the opening. The bottom is  $\frac{3}{4}$ -inch plywood, 28 by 34 inches, set in a groove  $\frac{3}{4}$ -inch deep in the sides of the base. This bottom piece provides a mounting surface for the light fixtures and

full-length shelves at the front and back of the table. Exterior edges were banded with a veneer to improve appearance. The light fixtures were wired into a toggle switch attached at the front of the unit.

# INDEX, 1964

(Numbers in parentheses are issue numbers)

- Aerial detection (*see* Fire, detection)
- Aerial photography, (2) 5,6
- Aerial survey, (2) 5
- Air patrol, (1) 15
- Anderson, Harvey T.
  - Brush Clearance for Structural Protection, (4) 9
- Anguilm, John A.
  - The Large Tanker — Extending Its Use, (1) 13
- Balloons, (1) 11, (2) 3
- Banks, Wayne G. and Silas Little
  - The Forest Fires of April 1963 in New Jersey Point the Way to Better Protection and Management, (3) 3
- Buildup index, (3) 3,5,6,9
- Bureau of Land Management
  - Summary of Fire Losses in Alaska, (1) 14
- Burgtorf, Carl
  - The Forest Service Specification Program for Fire Equipment, (2) 9
- Burnett, Howard
  - Propane Gas Installation for Lookout Tower, (3) 16
- Burning index, (3) 3,9
- Carberry, George
  - Retardant Hose Skate, (3) 14
- Chemicals
  - brush control, (4) 10
  - fuel stabilization, (4) 11
- Chester, G. S. and E. J. Hopkins
  - An Unusual Potential Cause of Forest Fires, (3) 12
- Clarke, Philip E.
  - Helmet Rack, (4) 12
- Community relations (*see* Public relations)
- Cooper, Horace G.
  - Modification of 3-way Valve on Retardant Pumps, (3) 15
- Conch, Joseph
  - Fire Prevention that Worked, (1) 8
- Coy, R. M.
  - Fire Retardant for Ground Attack, (2) 7
- Davis, Louis L.
  - Report on Aerial Fire Detection Study, (1) 15
- Detection (*see* Fire, detection)
- Devet, David D.
  - Deer Hunters are Careful with Fire When Properly Approached, (3) 13
- Division of Fire Control
  - Paper Packaging for Airdrops, (1) 12
- Drop pattern, (4) 8
- Equipment (*see also* Fire equipment; Fire suppression, equipment; Fire weather, forecast equipment)
  - development and testing centers, (2) 9
  - drafting, (4) 14
  - storage, (4) 12
- Equipment Development and Testing Center, Missoula, Mont.
  - Improved Lunch for Firefighters, (1) 10
- Ewart, Gerald F.
  - The Emergency Backpack Kit, (3) 10
- Fire (*see also* Forest fire)
  - causes, (4) 13
  - cross outs, (1) 11
  - detection, study, (1) 15
  - detection system, ground-air, (1) 15
  - hazard (*see* Management)
  - location plotting, (1) 11
  - losses (*see also* Fire, statistics), (2) 13, (4) 13
  - presuppression, (2) 16
  - retardant (*see* Retardant)
  - statistics, (3) 3,7,8; (4) 13
- Fire behavior (*see also* Forest fire behavior), (3) 4
  - fuel, (4) 9
- Fire conditions, (3) 3,4
- Fire danger, (3) 3,4
  - classes, (3) 9
  - ratings, (4) 3
  - stations, (4) 3
- Fire equipment (*see also* Equipment)
  - procurement, (2) 9
  - specification program, (2) 9
  - standards, (2) 10
- Fire hazard, (2) 11,13
  - management, (2) 14
- Fire prevention, (1) 8-10; (2) 12; (3) 5,6; (4) 9
  - legislation, (4) 9
  - presuppression, (3) 3,6
  - public relations, (3) 13
- Fire problem, (1) 4, (2) 12
- Fire suppression, (1) 13,14; (2) 7,16; (3) 3,4,6
  - cases, (4) 5,6
  - equipment (*see also* Equipment), (2) 8; (3) 4,6,10, 14-16; (4) 5,7
- Fire tower, (3) 16
  - orientation, (1) 11
  - sites, (2) 5
- Fire weather, (3) 3,7; (4) 4,9
  - forecast equipment, (3) 11
- Firefighters
  - diet (*see* Rations)
- Fireline construction, (4) 5
- Forest fire (*see also* Fire)
  - behavior, (1) 14
  - causes, (1) 8,9; (2) 10; (3) 3,7,12
  - expenditures, (1) 4,5
  - factors favorable to, (1) 4, (2) 11
  - fatalities, (1) 5
  - losses, (4) 13
  - rehabilitation, (1) 5
  - statistics, (1) 4,6,8,9,14,16
- Fuel (*see also* Fire behavior)
  - moisture, (3) 3,9
  - slash, sampling, (4) 11
  - types, (3) 4,12
- Graham, Howard E.
  - A Portable Fire-Weather Forecast Unit for Use on Back-Country Fires, (3) 11
- Hazard, (2) 14
- Hopkins, E. J. and G. S. Chester
  - An Unusual Potential Cause of Forest Fires, (3) 12
- Incendiarism (*see* Forest fire)
- James, Ralph A.
  - The New Bowles Helitank, (4) 7
- Johansen, Ragnar W.
  - Effect of Overstory on Ground Distribution of Airdropped Slurries, (2) 3
- Keetch, John J.
  - Developing a Network of Fire-Danger Stations, (4) 3
- Law enforcement, (1) 9
- Legislation, (3) 14
- Lightning, (1) 6
- Lufkin, Francis B.
  - Experiences with the One-Man Flail Trencher, (4) 5
- Management, (3) 3,6
  - fire hazard, (2) 14
- Mesavage, Clement
  - Drafting Table for Field Projects, (4) 14
- Mixon, James E.
  - A Technique in Tower Orientation, (1) 11
- Morrison, John
  - Fire Hazard Management, (2) 13
- Muraro, S. J.
  - Stabilization of Slash Fuel Samples, (4) 11
- Nelson, M. M.
  - The Place of Southern California in the Nation's Fire Problem, (1) 4
- Packaging, (1) 12
- Platt, C. F.
  - Aerial Survey of Tower Sites, (2) 5
- Prescribed burning, (3) 4-6

OFFICIAL BUSINESS

Index—Continued

Presuppression (*see* Fire prevention)  
Public Relations (*see also* Fire prevention), (1) 8-10  
Rations, field, (1) 10  
Retardant (*see also* Fire suppression, equipment)  
    airdropped, (2) 3,7  
    ground attack, (2) 7  
Rodney, Earnest A.

Forest Fires and Fire Weather Conditions in the Asheville, N.C., Fire Weather District—Spring Season, 1963, (3) 7  
Safety, (3) 10,16  
Spark arrester, (3) 14  
Stanford, Michael H.  
    Use of Air Pressure Powered Water Tanks in West Tennessee, (2) 8

Tanker, water boom assembly, (1) 13  
Tanks, water, (2) 8  
Taylor, Alan R.  
    Lightning Damage to Douglas-Fir Trees, (1) 6  
Tester, Merrill E.  
    Fire Hazard on Tobago, (2) 11  
Weather, observation systems, (*see also* Fire weather), (4) 3

Rack—Continued from page 11

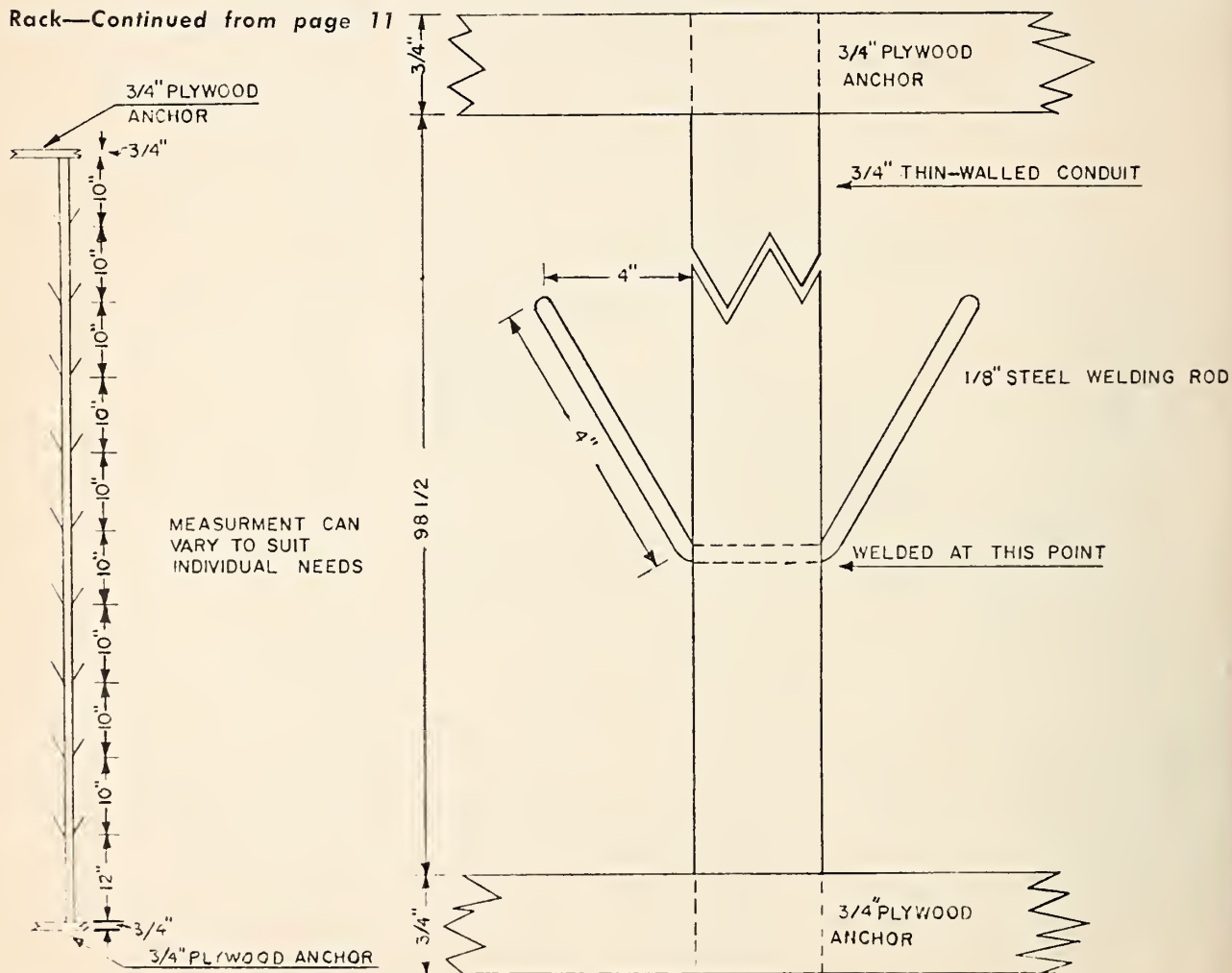


Figure 3—Specifications for smokejumper helmet storage rack. (Photo courtesy of U.S. Department of the Interior, Bureau of Land Management.)